

# MILITARY OPERATIONS RESEARCH SOCIETY



## **MORS Workshop Analysis for Non-Traditional Security Challenges: Methods and Tools**

21-23 February 2006

Johns Hopkins University Applied Physics Laboratory  
Laurel, Maryland

**Chairs:**  
Lee Dick, FS and Jim Harris

**20070924121**

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Form Approved  
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person should be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY)  20 November 2006	2. REPORT TYPE  Workshop Report	3. DATES COVERED (From - To)  21-23 February 2006		
4. TITLE AND SUBTITLE  <b>MORS Workshop Report Analysis for Non-Traditional Security Challenges: Methods and Tools</b>		5a. CONTRACT NUMBER  <b>N00014-04-C-0092</b> 5b. GRANT NUMBER  5c. PROGRAM ELEMENT NUMBER  5d. PROJECT NUMBER  5e. TASK NUMBER  5f. WORK UNIT NUMBER		
6. AUTHOR(S)  <b>Chairs: Lee Dick and Dr. Jim Harris Corrina Ross-Witkowski, Editor/Publisher</b>		8. PERFORMING ORGANIZATION REPORT NUMBER  <b>Military Operations Research Society, 1703 N. Beauregard St, Suite 450, Alexandria, VA 22311-1745</b>		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)  11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAILABILITY STATEMENT  <b>Distribution Statement A: Approved for Public Release; Distribution Unlimited</b>				
13. SUPPLEMENTARY NOTES				
14. ABSTRACT  <b>This publication is the report of the <i>Analysis for Non-Traditional Security Challenges: Methods and Tools</i> Workshop.</b>				
15. SUBJECT TERMS				
16. SECURITY CLASSIFICATION: <b>UNCLASSIFIED</b>		17. LIMITATION OF ABSTRACT <b>Unlimited</b>	18. NUMBER OF PAGES  1-122 Appendix A-1 thru D-1	19a. NAME OF RESPONSIBLE PERSON  <b>Corrina Ross-Witkowski</b>
a. REPORT  <b>Unclassified</b>	b. ABSTRACT  <b>Unclassified</b>	c. THIS PAGE  <b>Unclassified</b>		19b. TELEPHONE NUMBER (include area code)  <b>703-933-9070</b> <b>FAX: 703-933-9066</b>

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# PHALANX

Vol. 39 No. 2

(ISSN 0195-1920) • <http://www.mors.org>

June 2006

## MORS Workshop: Analysis for Non-Traditional Security Challenges: Methods and Tools

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Sunny Conwell, OPNAV N81, debra.conwell@navy.mil, Synthesis WG Chair

### Background

The current National Defense Strategy was built upon the efforts of the 2001 Quadrennial Defense Review (QDR) and the dramatic changes in the security environment and lessons learned in the post 9-11 world. That strategy identified four persistent and emerging challenges in this new, more uncertain area. The four challenges, traditional, irregular, catastrophic and disruptive, are depicted in Figure 1. The majority of modeling activity since the Cold War ended has continued to center on the analysis that supports traditional warfighting as we moved from the two simultaneous Major Theater Warfare strategies of the 1990s to the sequential Major Combat Operations strategy of this decade. As we attempt to seek ways to develop techniques to analyze the non-traditional areas, we have found that our familiar physics-based existing suite of tools are not well suited to examine the capabilities of the Joint Force against these new challenges.

During the 73rd MORS Symposium at the US Military Academy in West Point, NY, Mr Trip Barber, OPNAV N81B and Dr Jacqueline Henningsen, FS, USAFA9 (formerly AFSAA), discussed the need for a MORS workshop to facilitate community identification and sharing of tools, new techniques and methodologies and new developments. They wanted the workshop to provide immediate benefit to modeling developments and analytic support to provide insights to answer the post 2005 QDR questions within the Department and to

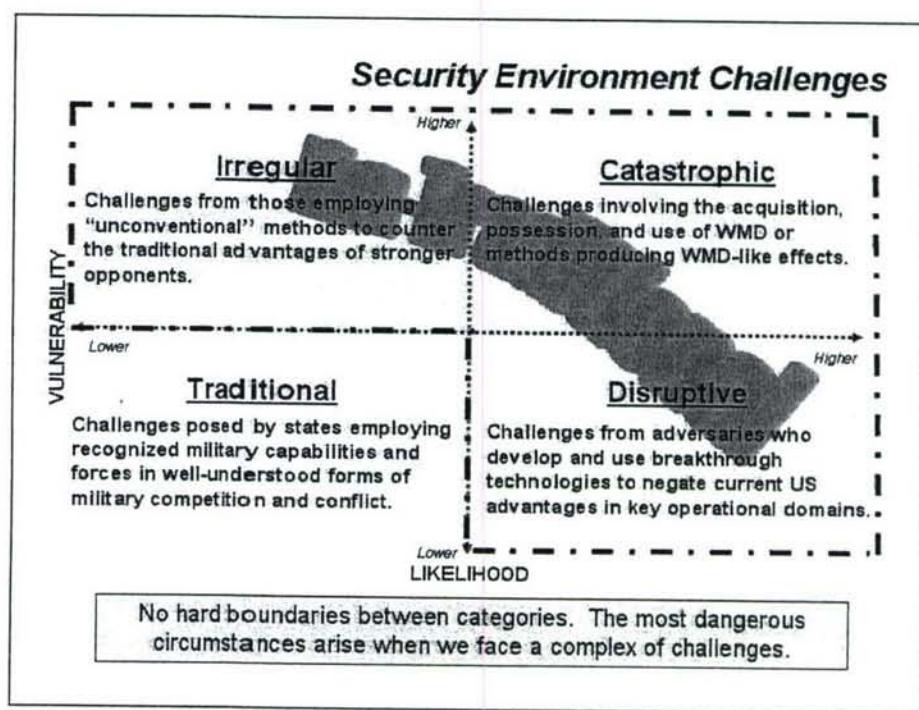


Figure 1. Non-Traditional Quadrants

support future analysis to support programmatic and acquisition decision making. Subsequently, Mr Barber and Dr Henningsen agreed to co-sponsor the workshop.

### Workshop Overview

Workshop preparations began in earnest in September 2005 with the approval of the Terms of Reference (TOR) by the MORS Executive Council and the identification of working group (WG) chairs. The workshop objectives as defined in the TOR are shown

in Figure 2. Working group chairs were selected early on and tasked with accomplishing a significant amount of pre-workshop preparation. This included identification of key stakeholders relating to each of the working groups, identifying their non-traditional analysis gaps and deficiencies, and populating working groups with the right match of stakeholders with a cross section of area/topic experts and modelers to encourage innovation and out-of-the box

(See *MORS WORKSHOP*, p. 32)

## MORS WORKSHOP

(continued from p. 1)

thinking. Working group procedures were issued four months prior to the workshop to serve as a guideline and aid in planning for the working group chairs. Organizing committee meetings were held every 2-4 weeks over the five-month period preceding the workshop. The Sponsors were updated with group plans and status in a face-to-face meeting with local area chairs approximately one month before the workshop. A second meeting was held the week prior to the workshop where final plans were briefed to the Sponsors. The success of the workshop was directly attributable to these pre-workshop accomplishments.

The 2006 QDR report and a draft of the new Strategic Planning Guidance (SPG) were released approximately one month prior to the workshop. As a result, each working group was asked to review the QDR report and draft SPG and refocus their efforts to be consistent with the new guidance.

The first half day of the workshop featured a plenary session to provide guidance and focus for the workshop breakout sessions. Col **Suzanne Beers**, USAF, MORS President, welcomed the participants. Col Beers was followed by Mr **Greg Melcher**, JHU/APL, who provided the host welcome. Dr Jacqueline Henningsen, FS, USAF A9, provided the Sponsor's welcome and introduced the keynote speaker, VADM **Evan Chanik**, Director Force Structure, Resource and Assessment Directorate, The Joint Staff (DJ-8). VADM Chanik's keynote, *Meeting the Nation's Challenges of Tomorrow – How the Operations Research Analysts Can Help*, provided insights to shape working group discussions. He identified five challenges for the workshop and for the Defense analytic community in general:

1. Continue to broaden open and collaborative environments to study issues concerning the Department of Defense;
2. Continue the work started in past workshops and the analytical methodology working group;
3. Identify required capabilities to fight our wars in the future;
4. Develop analytical methodologies to analyze non-traditional warfare; and,
5. Provide a list of gaps in tools and methods for development within the research community.

## Workshop Objectives

- Illuminate user Non-traditional modeling and simulation gaps and deficiencies in the context of the defense security challenges and emerging changes in the defense strategy
- Identify areas of user commonality
- Capitalize on Joint/Service/Agency toolsets and ongoing model development for the larger community
- Develop partnerships to share future M&S

Figure 2. Workshop Objectives

Other plenary speakers included Dr **John Hanley**, Institute for Defense Analyses, who discussed the applicability of traditional operations analysis techniques to non-traditional challenges, Dr **Ilana Kass**, Chief of Staff of the Air Force Cyberspace Task Force, who described the role of Cyber Warfare as both an irregular and a disruptive technology and challenged the audience to look for ways to analyze this aspect of the non-traditional spectrum, and COL **Patrick Kelly**, Office of the Secretary of Defense-Policy, who provided a snapshot of QDR and emphasized integrated, augmented and complementary analysis and the need to employ a broad array of methods and tools. Service perspectives were provided by Dr Jacqueline Henningsen, USAF A9, Mr Trip Barber, OPNAV N81, Dr **George Akst**, USMC MCCDC, and Dr **David Markowitz**, USA Center for Army Analysis who provided further challenges and focus for the audience.

### WG 1: Irregular Warfare/GWOT

WG 1 examined Irregular Warfare and the Global War On Terror (IW/GWOT) with an emphasis on those elements that did not appear to have clearly applicable methods for analysis. WG 1 used a combination of speakers, sub-working groups, scenarios, and other facilitation techniques to engage the audience in an attempt to "think outside the box." The use of sub-working groups helped to focus on specific areas. The sub-working groups designed and used scenarios as a tool to examine unique modeling and analytic challenges and stimulate discussion

on irregular missions. The WG focused on identifying tools and techniques that would help associate actions with effects and results for situations that are currently thought of as "hard" such as human decisions, the media, influence operations, or dealing with population dynamics. They approached this challenge by defining the problem, looking at existing techniques, and identifying new approaches. The three main WG plenary sessions were built around this concept. Finally, the WG organized their output in a process format starting with the question followed by data, analysis, tools new ideas and recommendations.

Getting the question right was identified as the most important step in the process followed by data collection. While the WG found there is potentially a dearth of data available, they concluded that collecting the data may be very difficult. Various methods of collecting data were debated including data mining and polling. Additionally, the WG noted there are barriers, such as political constraints, which may prevent collection of data at all.

One recurring subject of debate within the workshop was the role of scientific or operations research principles as they apply to non-traditional areas. Much DoD analysis and modeling up to this point has drawn on the physical sciences for insight regarding decisions and operations. However when confronted with IW/GWOT, a purely physical science model for gaining insight begins to break down. This means we may have to admit that not everything falls into

the category of things that are amenable to the approaches taken by the physical sciences. Secondly, we may need to manage risk associated with making decisions about processes that are not amenable to "scientific" methods. Many of our recommendations are about ways to help decision makers make better decisions and manage risk in situations where there is a single point solution.

In doing analyses it is helpful to have the right tools. The WG examined a variety of potential tools available to deal with these issues, but none of them stood out as a "gold nugget." The WG concluded that a variety of tools was needed, each with a potentially different theoretical or methodological approach, designed to provide a spectrum of insights to the decision maker. In addition, the WG found that most of the tools they examined were specialized, and thus required some modification in order to address a particular problem. Most of the models also tend to be complex and require an extensive developer/subject matter expertise base to set up and run.

The WG examined a number of missions to look for potential tools that would be useful in examining related questions. The proposed missions ranged from distributed operations to small unit operations. The WG found that few are well defined; some are overlapping, and some are not mutually exclusive. Since this taxonomy did not yield any insights into the complexities of the problem, the WG reverted to a more traditional set of definitions based on missions

assigned to special operations forces. The first step in finding potential tools was to examine the existing traditional warfare tool suite. Not surprisingly, artful use of traditional modeling and simulation (M&S) tools yields some very limited insights into IW operations that incorporate direct action. As expected, none of the traditional tools examines all aspects of the IW mission space. Most irregular warfare missions involve political, military, economic, sociological, informational, and infrastructure (PMESII) interactions in addition to military and as a result are not well addressed by traditional M&S tools (see Figure 3).

The WG also tried matching "unconventional tools" to the mission areas to assess model goodness. However, this was somewhat hampered by a lack of prior studies and analysis in the area of IW/GWOT. At present, there are few analytical agenda scenarios that cover the depth and breadth of IW. However, once these are completed and the analytic baselines developed, a better evaluation can be undertaken. These studies would also reinforce a best of breed model development practice to achieve better models to address issues in the IW arena.

There are multiple technologies that may be useful in examining IW including, but not limited to, agent based modeling, systems dynamics methods, and quantitative computational social sciences. It is not clear if any particular technique applied to IW problems will generate useful insights. Hence, the WG concluded a best of breed approach

is needed to develop better models, especially at the campaign level of analysis. The WG recommended that several different approaches should be pursued, leveraging prior research efforts where applicable. Various tools could be tried in prototype studies and the results could be fed back into the tool development process.

While little "low hanging fruit" was found, WG1 highlighted several key points and issues:

- **Board and Computer Games.** While games have been used by the military for many years to consider various issues, the WG felt that games and, broadly, gaming techniques, might be better able to address some of the issues that come up in dealing with populations and human factors. Research is needed to help determine the applicability of various gaming techniques to the IW/GWOT problems.

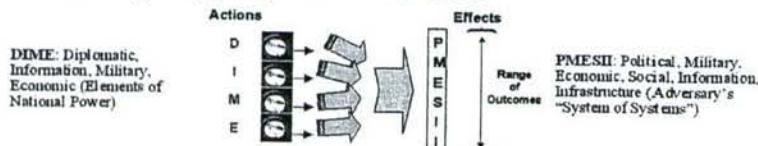
- **Analysis and Assessment of Risk.** Changing the way analysis is consumed may be the most important and cheapest way to implement insights gained from this WG. It may also be the hardest to implement. It would require that consumers of analysis develop ways to deal with uncertainty in the inputs and results. It would also require that the analyses be conducted in ways that balance risk, and develop multiple possible experimental approaches and outcomes. What level of uncertainty is too much in the results? How do you make decisions using outcome landscapes instead of single instance solutions?

- **Wargames and Simulations.** Expanding the role of wargames, especially for domains that do not lend themselves to modeling or where data is not available to support the model, would aid decision making. Wargames and simulations can sometimes be used to help frame and focus decisions and play both an analytical as well as a socialization role within the decision making process.

- **Ensemble of Approaches.** A range of theories, models, and methodologies, that yield a myriad of outcomes at different levels of fidelity are needed when addressing IW/GWOT. The WG was briefed on a recent DARPA effort that involved multiple competing models that examined government stability. Examining the "landscape" of model outputs provided greater insights than could have been gained by using an individual model. This

## DIME-PMESII Modeling Challenges

- Domain is large, nebulous, complex, and also not well understood because of competing theories and lack of empirical data. Consider:
  - expanding the role of analytical wargames as tools that support decision-making to scope the problem and identify key issues, and potential solutions
  - the use of commercial gaming environments.
  - use of polling, "expert" interviews, etc



- Irregular/GWOT problems often involve the "soft" or social sciences, e.g. human behavior, media, influence, populations, which poses a data problem (difficult to collect, messy, may be controversial).

Figure 3. Irregular/GWOT Considerations

## MORS WORKSHOP

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concept, of using multiple, different approaches to address the same problem was felt to be more appropriate for examining IW problems than any one, individual model or approach.

• **Verification and Validation (V&V).** Traditional methods used for validation may not apply to the issues discussed in this WG. It may be important to examine traditional assumptions about reproducibility and traceability that are required for valid operational analysis when considering subjects like human behavior, population dynamics, and other “soft questions.” Ultimately the question of “validation” comes down to the role of the decision maker and the degree of risk they are willing to assume in making a decision based on information that is not reproducible or “scientific” in the physical sciences sense. In the WG discussions, it became apparent that many of the questions that decision makers ask may not be answerable through traditional OR techniques.

In summary, WG 1 concluded:

- Problem definition is a critical path and will likely be a lengthy, iterative process for non-traditional areas.
- There is a great need for valid, real-world data to support modeling and analysis. It may be useful to examine the various impediments to collecting this data including legal, programmatic, and other issues.
- Using an ensemble of models may yield the “landscape” of outcomes for decision makers. One difficulty in this approach is how to reason across such an ensemble of disparate tools and methods and communicate the right outputs to the decision maker.
- The application of wargaming, simulations and commercial gaming techniques may be useful in gaining insights in IW/GWOT.

## WG 2: Disruptive

WG 2 was initially established to examine the Disruptive quadrant but this WG was later merged into WG 1 and WG 3.

## WG 3: Catastrophic

WG 3 made extensive use of pre-workshop surveys to identify gaps and shortfalls in the catastrophic quadrant. The WG began by deliberating “what constitutes a cata-

## WG 3: Catastrophic Current Analytic and M&S Capabilities

### • Current capabilities

- Engineering level: robust individual models: DTRA Suite, CAPS
- Tactical / operational level: EPICS, JCATS, IWMDT
- Campaign level: legacy models (ITEM), but these are not tailored for domestic catastrophic events
- Training models: significant lack of simulator/stimulators/facilities

### • Applications/examples – many stand alone tools: multiple tools often required to assess a scenario

- Defense Collaboration Tool Suite/InfoWorkSpace (DCTS/IWS)
- Hazard Prediction Assessment Capability (HPAC)
- Consequence Assessment Toolset (CATS)
- Integrated Munitions Effects Assessment (IMEA)
- Vulnerability Assessment and Protection Option (VAPO)
- Traditional campaign analysis/mission level tools re-purposed to assess catastrophic scenarios

Figure 4. Catastrophic Toolset

strophic event” and in doing so examined the 15 National Planning Scenarios developed by the Homeland Security Council and Department of Homeland Security (DHS). Several of these scenarios involve significant loss of life and/or significant social, political, economic, or psychological effects. The other component of the catastrophic quadrant, “Countering Weapons of Mass Destruction (WMD),” was defined by the WG to include events involving WMD interdiction, counter-proliferation, and deter/defeat the use of WMD by state and non-state actors.

The WG concluded that the majority of the current M&S tools and capabilities that address the two catastrophic areas are at the engineering and mission areas of fidelity. There are a few tools available at the tactical level. There is some effort being applied to use some of our legacy campaign models (such as ITEM) in the Homeland Security (HLS)/Homeland Defense (HLD) arena, but generally these tools are not tailored for analysis of domestic catastrophic events.

The applications/examples shown in Figure 4 are just the tip of the iceberg with regard to our ability to model WMD effects. These tools are generally very good at modeling first order effects and the spread/transmission of those effects from the source through the “target” area. Generally, these tools are stand-alone and not interactive

models. The Defense Threat Reduction Agency (DTRA) is currently involved in enhancing several of the M&S tools to better support their warfighter customer. These tools will become part of the Integrated WMD Toolset and will be available through a reachback function centered on the DTRA Collaboration Center.

Key analysis gaps and deficiencies and stakeholder commonalities were drawn from the pre-workshop surveys and further refined during the workshop. These are depicted in Figure 5. The WG acknowledged analyses work needs to be coordinated or collaborated across all stakeholders, since the plans/CONOPS for each stakeholder will be influenced or dependent on that of the other stakeholders. These stakeholder interdependencies must be captured in the modeling/analysis to provide accurate outputs.

The WG felt analytical support of/participation in exercises and wargames appeared to be the best starting point for eliciting the data that will clarify stakeholder roles and capabilities for HLD. The WG concluded that breaking down barriers between analysis communities within DoD and between agencies would be facilitated by a standard data format and by methods for navigating around classified data.

The WG identified primary M&S shortfalls and gaps in the areas of data, CONOPS,

and methods/tools.

In addressing data, the WG saw three major deficiencies:

1. A lack of data concerning the capabilities of the local, state, other federal, Non-Government Organizations, and international agencies. It is extremely difficult to predict what capabilities will be requested from DoD in response to a catastrophic event when we have no idea of what portions of the response activities can be handled before DoD is requested to "enter the fight."
2. The lack of tools in the biological area. This is especially true concerning some of the newer/engineered bio threats and with the retransmission or secondary infections from the agent.
3. The lack of current empirical test data available to test our models/tools against. For example, in the nuclear arena, the last open air nuclear test was conducted in 1962 and the test data collected in that and previous tests did not have the fidelity that we would want to collect today.

In the area of CONOPS, while there has been some effort to determine what capabilities/ tasks are required in response to a catastrophic event, the WG ascertained there have been no real efforts to determine how these responses need to be time-phased. The

majority of the tools that support the catastrophic area are effects related and are therefore related to consequence management. The WG found a distinct lack of effort concerning analysis of pre-event capabilities. This may be related to the lack of appropriate metrics in this area. For example, how do you measure success with regard to preventing or deterring a WMD event?

Regarding methods and tools, the WG identified the following concerns: 1) the results from one model are not directly usable as inputs to another model; 2) there is a lack of tools to do biological event modeling; 3) there are large gaps in our tools to examine the socio-economical, psychological, and political effects of a catastrophic event; and, 4) there is no aggregated tool to examine effects at the campaign level.

The WG concluded there are no simple "tool" solutions to the analysis of catastrophic scenarios. The community needs new tool/modeling/analysis ideas and concepts. Partnerships between the various stakeholders also need to be developed. WG 3 separately reached the same conclusions that were developed in WG 1 — first and most important is defining the problem correctly and then identifying and gathering data before developing new methodologies and tools.

In summary, the WG noted that there is generally a lack of models/tools above the

engineering or systems level of fidelity. Before development of higher level, more aggregated models can proceed, the focus should be on developing good data and sources for that data. This may be facilitated by the establishment of a robust interagency community of interest in the catastrophic arena. The WG also saw a need to divide the catastrophic mission area into pre- and post-event areas. Current efforts seem to be focused on the post-event or consequence management actions, but we cannot afford to neglect analysis focused on preventing or deterring catastrophic events.

#### WG 4: Deterrence

Using the Strategic Deterrence Joint Operating Concept (SD JOC) as the conceptual basis, WG 4 posited three questions to help frame discussions within the working group. These questions address three persistently thorny issues concerning deterrence analysis.

1. *How can analysts characterize and measure uncertainty concerning deterrence?* Uncertainty comes in a variety of forms, including: the uncertain nature of the problem, intelligence available to inform the analysis, completeness of understanding of the adversary's decision making process, our ability to develop and communicate deterrent actions, the manner in which deterrent actions are received, unplanned actions that have unintended consequences, and the dynamic nature of strategic events. For example, how do we account for learning by unidentified (i.e., potential) adversaries?
2. *How can deterrence analysts determine and manage second- and third-order effects in deterrence analysis?* While we have methods to identify, and to some extent measure, the main effects (or intended effects) of our deterrent actions on adversary decision making, we have difficulties in identifying and accounting for cascading effects that come in a variety of forms. Some spillover effects are geographical (e.g., neighboring, regional, global); some are temporal (e.g., short term deterrence may contribute to longer-term instability); while others cross disciplines (e.g., economic actions having a diplomatic effect).
3. *How can analysts estimate the magnitude of an adversary's response to a proposed*  
*(See MORS WORKSHOP, p. 36)*

### WG 3: Catastrophic Analysis Gaps and Deficiencies

#### • Key stakeholders and decision-makers

– USG (Inter-agency)	◆ DOD/Services/COCOMS	◆ Local Govts
– Allies	◆ Coalitions	◆ Industry
– State/Territorial Govts/NG	◆ National/private Labs	◆ First Responders

#### • Key analysis gaps and deficiencies

- Perceived lack of objective goals, defined responsibilities, action/resources reflecting stated priorities
- Need for improved interagency cooperation/collaboration/data sharing
- Insufficient understanding of complex, primary effects and secondary effects (political, economic, social, psychological)
- Little quantification of local, state, federal, DoD, and int'l response capabilities
- Immature/non-existent operating procedures, data, tools for evolving mission and requirements
- Barriers to sharing data, plans (classification issues, terminology, ontology)

#### • Commonalities between stakeholders

- Desire for comprehensive, systematic, interagency analysis
- Desire for integrated, tactical/operational tools
- Need to plan for response & future investments
- Mission focus

Figure 5. Catastrophic Gaps and Deficiencies

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(continued from p. 35)

friendly deterrent action? In most cases, we have methods to determine the general nature of an adversary's response to a specific deterrent action (e.g., favorable, unfavorable). What we lack are methods to determine "how favorable?" or "how unfavorable?" that will ultimately help us develop coherent packages of deterrent actions.

As an initial synthesis of the groups' discussions, Figure 6 depicts the multi-dimensional nature of the problem contrasted with some of the more promising operations research (OR) methods and tools available to aid in deterrence analysis. The group immediately and unanimously saw the need for a suite of tools for even the most basic of deterrence analysis problems. This concurs not only with the other working groups, but also with the findings from other analytic venues. Underlying this suite of methods and tools is the need for data, and the nature of that needed data is changing, just as the concept has changed. The reminder at the bottom of the chart serves to bring us back to the sometimes-overlooked mandate to define the problem correctly (i.e., getting the question right). In this case, the focus of a substantial part of deterrence analysis is to help develop sets of actions that will serve to achieve deterrence or stability. What is often discussed, however, are the difficulties we have in quantifying the probability of an adversary's response. While interesting, that problem is usually not the effective focus of the analysis and serves to distract the analysts and decision makers. In total, this graphic represents an initial functional decomposition of the problem and helped the working group next identify gaps and potential solutions.

Combining the functional decomposition with the understanding of an engineering design process yields a framework to assess method and tool availability for deterrence analysis. This is certainly not a definitive mapping of tools to problems! In fact, even if we could account for all significant methods and tools, the mapping would be incomplete since it potentially changes based on the nature of the problem. This means the problem definition step in part determines which tools are appropriate for analysis. In some cases, these methods

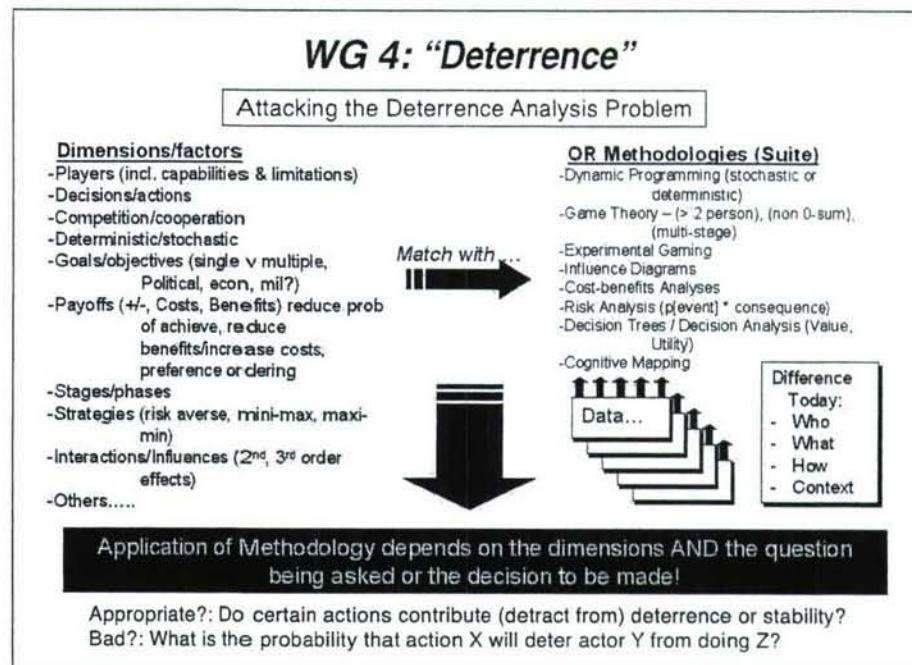


Figure 6. The Deterrence Problem

and tools have already been applied to the indicated analytic tasks and in other cases, they have not. More importantly, the group identified a number of tools that *theoretically* could be applied to certain tasks, but whose data collection would likely drain the national budget, or are otherwise completely infeasible. For example, mathematical network models used to examine complex systems might aid in understanding decision making processes in terrorist networks, but that understanding would likely require describing each node and edge in the network to some sufficient level.

While the method and tool mapping highlights some general potential, it does not capture specific strengths and weaknesses, which specific tools are best suited for specific problems, or what priorities among tools and gaps. Instead the WG drew these general conclusions:

- As expected, there is no "perfect storm" that will address all, or even most, of the aspects of the deterrence analysis problems.
- We face significant gaps in two of the three focus areas laid out at the beginning: determining the impacts of second and third order effects, and determining the magnitude of an adversary's response. However, the focus area of characterizing, reducing and managing uncertainty may well be substantially covered by well developed risk analysis methods.

- As mentioned previously, the data requirements for some approaches likely rule out the practical use of those approaches.
- Because of the lack of data problem, the human-in-the-loop (HITL) approaches (e.g., role playing, wargaming) are often the best choice. This is completely reasonable given the current state of the art for deterrence analysis. HITL methods are often excellent, and inexpensive, choices for addressing formative problems.

The timing of the workshop was opportune for the further development of the deterrence concept. USSTRATCOM is DoD's agent for maintaining and revising the Strategic Deterrence Joint Operating Concept (SD JOC). In February 2006, that concept was mid-way through its first revision and the officer from USSTRATCOM responsible for that revision was a participant in this WG. Accordingly, the insights gained during the workshop are being incorporated into the SD JOC revision.

## WG 5: Decision Making and Integration

Initially the co-chairs of WG 5 struggled with the definition of "decision making and integration" as applied to this workshop. Numerous discussions with workshop sponsors resulted in a refined charter that

focused on assessing the implications of QDR 2005. Specifically, the group focused on assessing the ability of the Department to examine the capabilities that QDR identified as critical for meeting the strategic, operational and tactical objectives of four focus areas:

1. Defeating terror networks;
2. Defending the homeland in depth;
3. Shaping choices of countries at strategic crossroads; and,
4. Preventing the acquisition or use of WMD.

In order to provide context for follow-on analysis, WG 5 debated the future environment, including potential changes to the threat, strategic drivers and advances in technology. Under this redefined future, considerations for future force employment were discussed, and then mapped to the set of required capabilities listed in the 2005 QDR report.

To accomplish this task the WG subdivided itself into four subgroups — one for each of the four QDR focus areas. Each group was provided the same task, and asked to proceed independently. The objective was to look at each focus area and integrate the results, identifying common elements of the assessments of future threats, the strategic environment and opportunities. The groups were also asked to identify key decision makers — and postulate the type of questions they might ask in each of the four focus areas.

In describing the future environment, the sub-groups concluded:

- The proliferation of data and information, coupled with the ability to rapidly share that information, creates a level playing field for the US, and its partners and adversaries. While data is expected to be plentiful, the challenge will continue to be in mining information to find elements that contribute to problem description, analysis and solution.
- Uncertainties in the expected degree of government agency cooperation, future levels of funding and the evolution of partnerships (both within the structure of government and internationally) present challenges for effective defense of the homeland.
- The future environment will be complex and driven by numerous factors. Shaping objectives will be complicated by interests that extend beyond traditional government relationships, and will be

influenced by differing levels of technological capability, operational capabilities and system interoperability amongst cooperating military forces, law enforcement and other agencies.

- Future catastrophic events will shape American policy, decisions and courses of action.

All four subgroups identified opportunities for (and perhaps, the necessity of) increased cooperation, collaboration and integration across organizational boundaries. The groups felt that the nature of the non-traditional security challenge will require cooperation and integration; not only organizationally, but from force planning, resource allocation and operational perspectives as well. The groups saw the first step for military operations research analysts as increased multidisciplinary participation in studies and analyses and surmised that we will need to include psychologists, sociologists, economists, international relations experts, and many other disciplines.

The WG found that deficiencies lie in our ability to measure how well these capabilities answer non-traditional security challenges, and that these shortfalls will need to be mitigated in order to better understand resource allocation requirements — not only within DoD, but across all government agencies tasked with supporting response to non-traditional security challenges we will

face during the long war. As depicted in Figure 7 the WG presented some analysis that indicates that the nature of these challenges may call for a broadening of our analytic toolkit, to include wider use of social science and risk analysis methodologies, particularly in the areas of WMD and defense of the homeland.

In conclusion, WG 5 agreed that the uncertain and potentially dangerous future requires the use of scenario-based planning. The scenarios must be creative enough to enable us to think like our adversaries. The ability to analyze complex and adaptive adversaries will be critical, and analysis augmented by “red cell” insights and the social sciences will be necessary.

### Concluding Remarks from the Synthesis Group

In assessing the common themes across all working groups, the Synthesis Group focused on people, data and V&V.

**People.** A common denominator across the working groups was the recognition that the military operations research community (which is currently largely comprised of mathematicians, physicists, ORs, engineers and scientists) will need to be augmented by other disciplines such as sociology, anthropology, regional experts, economy, political science, and psychology. It will not be

(See *MORS WORKSHOP*, p. 38)

### • Potential Resource Allocation Methods\*

- New focus on risk analysis methods

QDR Focus Areas	Large Simulations	Model(s)	Benefit/Cost Analysis	Risk Analysis	Gaming
Defeat terrorist networks	Potential in Long Term		FY08 POM & Long Term Goal		
Defend Homeland in Depth				FY08 POM & Long Term Goal	
Shape choices of countries at strategic crossroads		Potential in Long Term			FY08 POM
Preventing the acquisition or use of WMD	FY08 POM & Long Term Goal	FY08 POM		FY08 POM & Long Term Goal	

\* Caution – WG 5 did not examine specific models and simulations.

### • Next steps

- For each QDR focus area and across the focus areas
  - Use creative new scenarios
  - Define functions
  - Identify capabilities to perform functions
  - Develop measures for each capability
  - Develop models and simulations to calculate measures

Figure 7. Analysis Methods for QDR Focus Areas

## MORS WORKSHOP

(continued from p. 37)

sufficient to leave these disciplines to academia and reach back to sufficiently address non-traditional areas. We need multi-disciplinary teams within the Department to work collaboratively on the analytical issues for non-traditional warfare.

**Data.** Physics-based data is well understood by the MORS community. The soft sciences are, however, a fairly new domain. The design of experiments will also be very important. Methods for collecting data will have to be improved. Many data sets will be noisy or sparse and different techniques for analysis will be required. Data mining technologies will need to be incorporated. Sources that are outside of the norm will be required such as mining newspapers, industry reports, global/regional economic data, web postings, political satire, academic publications, etc. Defining how data feeds models and methods will likely be more challenging.

**V&V.** V&V was a common theme in working group discussions. There is clearly a need for reasonable and sufficient V&V, while realizing the difficulty of accomplishing V&V when there is little real world history or test results to form a basis of comparison. Also, there is a need to accomplish V&V of the analytic methods and the supporting data to build the confidence of decisions makers when presented with analysis using new methods and tools and relying on data from unfamiliar data sources.

In conclusion, the Synthesis WG assessed the workshop accomplishment in terms of achieving its objectives of reviewing current data processes, identifying best practices and standards, identifying and assessing potential sources of data, and educating the community on the new data directive. The WG concluded the workshop made excellent progress on two of those objectives (i.e., review current data processes; and educate the community on the new data directive), and good progress against the remaining two objectives (i.e., identify best practices and standards; and identify and assess potential sources of data). Given the highly complex, multi-dimensional problem of interest, these are major accomplishments.

## Methods and Techniques

- Seminar wargaming
- Human-in-the-loop simulations
- Commercial gaming environments
- Graph theory and network analysis
- Influence and Bayesian network tools
- Game theory
- Risk analysis
- Value focused thinking
- Analytical hierarchy process
- Interviews and Polling
- Lessons Learned Data
- Data Mining
- Historical Studies

Figure 8. Potential NTM Analytic Methods and Techniques

### Overarching Recommendations and Way Ahead

**Overarching Recommendations.** While there is some new tool development ongoing, the workshop concluded that there are no “revolutionary” new tools. Rather, we are still largely engaged in defining the problem, identifying and gathering data, and investigating many different methodologies for analysis. Some emerging tools were identified which are worth investigating for the purposes of exploring competing theories, examining consequences of explicit or tacit assumptions and providing structured framework for ideas. However, in taking a holistic approach to this type of analysis, a wide range of techniques should be considered. Some examples are depicted in Figure 8.

To the extent possible, stakeholders should leverage other ongoing efforts, such as DTRA’s Modeling Suite for CBRNE and OSD’s Irregular Warfare Suite. In addition to participation in MORS events, we also need to investigate other forums to share ideas and approaches for analysis of non-traditional areas.

**Way Ahead.** This workshop constituted a “step along the way,” not an end. It should be considered just one in a sequence of workshops that will help the defense analysis community develop new methodologies, methods, and tools to address the non-traditional challenges. This includes developing methodologies that facilitate assessing

and balancing risk and the appropriate V&V for those methodologies that will enable decision makers to quickly develop an understanding of the resulting analysis and confidence in those results.

Finally, as we introduce new methods and tools it will take time for the decision makers we support to develop the level of understanding and comfort they have in studies using the methods, tools and models they are familiar with from years of seeing the results of studies using the MCO-based scenarios. All of the working groups recognized the fact that we need to first understand the types of problems we are attempting to solve and the need to step through a 1st order solution process. Models may not be required to solve the problem, but if a model is required or useful, recognize the need for having an ensemble of available models that we can use when trying to solve the problem at hand. Most importantly, DoD must ensure that it remains a proactive participant, along with the other communities identified, in the problem solving process.

### Contributors

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### Biographies

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## **Analysis for Non-Traditional Security Challenges: Methods & Tools**

### **Military Operations Research Society (MORS) Workshop**

#### **WG 1 - GWOT/Irregular Outbrief**

This is the out brief from Working Group 1. We examined GWOT and Irregular Warfare with an emphasis on those elements that we did not feel had clearly applicable methods for analysis. The working group was composed of 80 registered individuals of which 55-60 attended on a regular basis and was divided for part of the time into ten sub-working groups. At least 60% of the individuals identified themselves as operations research analysts; all of the participants are responsible for supporting their Service, COCOM, or agency with analysis on irregular warfare problems. Individuals were present from the Joint Staff, the Services, SOCOM, CIA, academia, industry, FFRDCs, UK, and Canada. The sub-working groups conducted a scenario-based analysis of our modeling and analysis capabilities for GWOT and Irregular Warfare related areas. The sub-working groups used the scenarios as a tool with which to focus on specific modeling and analysis challenges.

This briefing is structured as follows: 1) a briefing on the overall results from the working group plenary sessions; and, 2) show two individual slides, and two full briefings, from different sub-working groups. Because there were ten total sub-working groups it was not possible to show the outcome of all sub-working groups.

# WG 1 - GWOT/Irregular Participants

Anthony, Mr. Marvin C.	Naval Sea Systems Command AFIT/ENS OPNAV N81 Group W	Lidy, Mr Albert Martin Loy, Mr Richard J.	Institute for Defense Analyses Lockheed Martin Missiles and Fire Control
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Batcher, Dr Robert T. Bilyeu, LTC Allan Leon	Northrop Grumman Data Research and Analysis Corp.	Markowitz, Dr David M. Maxey, Mr John	Center for Army Analysis AF/A7CXR (Contractor)
Bitinas, Mr Edmund J. Booth, Ms Carol	SMC/SYY Alion Science and Technology	McComas, Ms Lesa A. McDonald, Ms Mary Leonardi	JHU/APL
Bridges, Maj Yusef Budge, Mr Larry D.	Northrop Grumman METRON, INC.	McGrady, Dr Ed McNerney, CDR Thomas III	Systems Planning and Analysis, Inc.
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Collier, Mr John	OPNAV N81 Eagan McAllister Associates	Mock, Mr Sherrel Wayne Muccio, Mr James	OPNAV N81
Colton, LCDR Kyle James Comer, Mr Kenneth W.	OPNAV N81	Nixon, Mr. Michael Joseph Ottenberg, Mr Michael A.	Hicks & Associates, Inc.
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Dallas, Mr Andrew Debrine, LCDR Jeffrey	Soar Technology Inc.	Redman, Mr Daniel Rigazio, Mr Richard C	DMSO
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Dunlap, Mr Preston Edson, Mr Robert	OSD/PA&E ANSWER	Shepherd, Mr John E. Siegel, Mr Neal W.	RAND Corp.
Eles, Dr Philip T.	Department of National Defence	Simmons, Dr L. Dean Smith, Dr Jerry R.	AT&T Government Solutions
Elton, Mr Olaf L. Farley, Mr Steve	MITRE	Smith, Mr Robert D. Snevely, Mr John A.	Aptima, Inc.
Fitzsimmons, Mr Michael Frank, Mr. Aaron B.	OPNAV N81 IDA	Staniec, Dr Cyrus J. Stephens, Mr Cortez D. (Steve)	MITRE Corp
Garcia, Mr Dennis J. Garfield, Mr Andrew	BAE Systems CIA	Syring, Ms Ronda J. Vanden Bosch, Col (s) Peter M.	Northrop Grumman
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Helgerson, Mr David E.	Center for Army Analysis CSC Advanced Marine Center		Visco Consulting
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			OPNAV N81

## WG 1 - GWOT/Irregular



- **Complex topic**
- **Focused on**
  - ◆ Action -> Effect -> Results
  - ◆ Hard problems involving
    - Human factors, media, influence and populations
    - DIME/PMESII
    - Analysis in support of Headquarters, Combatants, not training etc.
  - ◆ Understanding the problem and existing techniques
  - ◆ Identifying new approaches that would work
- **Structured results as process**

We felt a complex topic required an innovative approach toward this working group. Thus we used a combination of speakers, sub-working groups, scenarios, and other facilitation techniques to engage the audience in an attempt to think outside the MORS box. We believe we accomplished that goal.

The working group focused on what we considered to be the overall charter from the Sponsors: to identify tools and techniques that would help them associate actions with effects and results for situations that are currently thought of as hard. Examples of hard problems include anything having to do with human decisions, the media, influence operations, or dealing with population dynamics. We approached this challenge by trying to understand the problem, look at existing techniques, and identify new approaches. The three main plenary sessions were built around this concept.

The rest of the main portion of this briefing is structured around a concept of the analytical process, starting with the question and ending with the tools needed to conduct analysis. The completion of this working group brief will discuss new concepts and WG recommendations.

## WG 1 - It's a Process

- The question
- The data
- The analysis
- The tools
- New ideas
- Recommendations

This is the process for the WG 1 brief, essentially an outline of both the briefing and any analytical process. After this section of the brief there will be briefings from the sub-working groups.

## WG 1 - Get the Question Right



- **Goals and questions are often unclear**
  - ◆ We may lack basic frameworks for understanding the problem
    - Use frameworks where they exist
- **You can model anything, but it may ultimately not be very helpful**
- **The question is important**
  - ◆ Because soft issue models often need to be customized for the question
  - ◆ And data may not exist, or may be complicated and difficult to collect

The most important thing you can do to ensure an analysis (or model, or game) will be successful is to make sure you are answering the right question. Unfortunately in this area we may lack basic frameworks that allow us to understand enough to ask the right questions. During the final plenary session we had a discussion of frameworks for the interagency aspects of irregular warfare, something that is both challenging and necessary if we are to be able to understand enough to build appropriate analyses.

Unfortunately, even if you don't ask the right question, it is possible for analysts and modelers to go off and start working anyway. Usually what happens is that the sponsor realizes that the analysis is heading in the wrong direction and provides course correction. Unfortunately getting the question wrong may be more dangerous in this case. In our plenary sessions we found many of the models we were dealing with needed to be modified or customized for each question. Likewise data was non-existent and difficult to obtain. If models have already been modified, or the wrong data obtained, it may be more difficult in this case to change the question than it is during a conventional analyses.

## WG 1 - We Need Data



- Lack of data poses a significant problem
- Discussed polling as an example
  - ◆ Legal constraints
  - ◆ Political constraints
  - ◆ Methodological constraints
- Much of the data we need involves “human” data that is difficult, messy, and controversial to collect
- Simulations can only go so far when compared to real world data

During the course of our discussions there were several recurring themes. One was that there is a dearth of data that can support our analysis, or help us with our models. Polling was discussed as one example of a data source that would be helpful (if done correctly) but is difficult to obtain. There appear to be various legal, political, and methodological constraints to conducting polls for purposes of analysis.

In general this points out that, for the type of problems we are considering here, collecting the data may be difficult. As people are involved there may be human subject research protocols that need to be followed. As the people may be from sensitive populations, political considerations may prevent much data from being collected. This limitation is one that may need to be considered if the goal is to improve our ability to analyze these types of problems.

Unfortunately simulations can only go so far when compared to real-world data. Analysis based on data, even fuzzy, messy, data is much more likely to provide decision maker insight than simulation results alone.

## WG 1 - The Analysis



- **Operations research is the application of scientific methods to operational problems**
  - ◆ We may have to admit that some things do not fall into the category of physical science
  - ◆ This means managing the risk associated with decisions in new ways
- **We may want to explore**
  - ◆ New decision making models and processes
  - ◆ Tools that may not be capable of being validated
  - ◆ New techniques, such as multiple instances of models and theories

Once the data is collected and the questions asked, it's time to do the analysis. One recurring subject of debate within the conference was the role of scientific or operations research principles as they apply to the types of problems we are discussing here. Much DoD analysis and modeling up to this point has drawn on the physical sciences for insight regarding decisions and operations. However when confronted with GWOT or Irregular Warfare a purely physical science model for gaining insight begins to break down.

What does this mean?

Well, first we may have to admit that not everything falls into the category of things that are amenable to the approaches taken by the physical sciences.

Second, if we accept the first, then we may need to manage risk associated with making decisions about things that are not amenable to scientific methods. Much of our recommendations are about ways to help decision makers make better decisions and manage risk in situations where there is no one right answer.

## WG 1 - The Tools



- **No new or revolutionary tools**
- **Considerable skepticism about any one model's ability to solve a problem**
- **All the existing tools tend to be**
  - ◆ Specialized
  - ◆ Expert intensive

In doing analyses it is helpful to have tools. Much of our working group's discussion was about tools, do they exist, what can they do, is there anything really important that we are missing?

The answer was not much. While there are tools available to deal with these issues, none of them stood out as the "golden BB" that we were looking for. In fact there was great skepticism about any one model's ability to address a particular problem. As shown later the WG concluded that what was likely needed was a variety of tools, each with a potentially different theoretical or methodological approach, designed to provide a spectrum of answers to the decision maker.

In addition we found that most of the tools we considered were specialized, and thus required some modification in order to address a particular problem. The models also tended to be "expert intensive" in terms of needing execution support from those who built, or at least were well trained in, the model.

## WG 1 - Existing Models



Core IW Missions	MORS Workshop Issue Areas	Traditional M&S Tools
Counter – Proliferation		Not Directly Applicable
Counter Terrorism	Counter-terrorism, Terrorist Networks, Critical Infrastructure Protection, Maritime Domain Awareness, Partnering/Shaping, Distributed Operations and Small Unit Operations	Not Directly Applicable
Unconventional Warfare	Small Unit Operations and Distributed Operations	JICM, JWARS? (during latter phases of the UW Campaign Only)
Special Reconnaissance		JICM, ITEM, THUNDER, JTLS, JWARS, COSMOS*
Direct Action	Small Unit Operations and Riverine Operations	JICM, ITEM, THUNDER, JWARS, AMP, JTLS
Psychological Operations		JICM
Civil Affairs Operations		JTLS
Foreign Internal Defense	Foreign Internal Defense, Counter-insurgency, Partner Shaping, Distributed Operations, Small unit Operations and Riverine Operations	JICM, JWARS, JTLS
Information Operations		ITEM, THUNDER

\* COSMOS is a mission level ISR model

The WG was tasked to examine a number of missions and find potential tools that would be useful in examining related questions. The proposed missions ranged from distributed operations to small unit operations. Few are well defined; some are overlapping, and some are not mutually exclusive. Since this taxonomy did not yield any insights into the complexities of the problem, the WG reverted to a more traditional set of definitions based on missions assigned to special operation forces. The first step in finding potential tools was to examine the existing traditional warfare tool suite. Not surprisingly, artful use of traditional M&S tools yields some very limited insights into irregular warfare operations that incorporate direct action. As expected, none of the traditional tools examines all aspects of the irregular warfare mission space. Since most irregular warfare missions are only 20% military, the remaining 80% of the problem — political, military, economic, sociological, informational, and infrastructure (PMESII) — are not addressed by traditional M&S tools.

## WG 1 - Unconventional Tools



Core IW Missions	IW M&S Tools	Traditional M&S Tools
Counter - Proliferation	Direct Combat Model (JCATS)	Not Directly Applicable
Counter Terrorism	PMESII (SEAS - VIE, GS/ERIS) Direct Combat Model (JCATS)	JICM, JWARS, JTLS Not Directly Applicable
Foreign Internal Defense	PMESII (SEAS - VIE, ERIS, MIT System Dynamics Model, Agile, GS/ERIS, PSOM, MASON, CASS, Framework, SIAM, ERIS, IBC, DIAMOND-US) Direct Combat Model (JCATS)	JICM, JWARS, JTLS
Special Reconnaissance	Direct Combat Model (JCATS) Python scripts	JICM, ITEM, THUNDER, JTLS, JWARS, COSMOS*
Direct Action	Direct Combat Model (JCATS)	JICM, ITEM, THUNDER, JWARS, AMP, JTLS
Psychological Operations	PMESII- (SEAS - VIE, Advertising, Psychological, Political, etc), SOF Behavioral Analysis Tool (Pythagoras)	JICM
Civil Affairs Operations	PMESII-TBD	JTLS
Unconventional Warfare	PMESII (SEAS - VIE, MIT System Dynamics Model, Agile, GS/ERIS, PSOM, MASON, CASS, Framework, A Force More Powerful, SIAM, ERIS, IBC) Direct Combat Model (JCATS) SI - semi-annual (Virginia, Louisiana, DOD, COTUS) DIAMOND-US Pythagoras Liberia, Semi-static Stability Model	JICM, JWARS? (during latter phases of the UW Campaign Only)
Information Operations	PMESII-TBD (SEAS - VIE, Advertising, Psychological, Political, etc), SOF Behavioral Analysis Tool (Pythagoras)	ITEM, THUNDER

Tools:

- Green = On hand Tool
- Blue = Potential Tool
- SS = Tool requiring validation and development effort
- Purple = Candidate Tool requiring further assessment
- Red = Future capability

\* COSMOS is a mission level ISR model

Next we added in “unconventional tools” both real and potential, and matched them to the mission areas. Irregular warfare modeling and simulation tools can be applied in kinetic (Direct Combat) and non-kinetic (PMESII) arenas at most levels of analysis. Note that engineering, system, and mission level models are not very applicable to irregular warfare analysis. In general, at the tactical level of analysis, JCATS is a world class model for examining irregular warfare issues dealing with direct combat. To achieve several of the mission areas stated in the WG charter, JCATS may have to be implemented in unique, non traditional ways or be augmented with other models. For example, riverine operations ... primarily a type of direct operations ... may be analyzed through the use of GCAM and JCATS. At the operational level of analysis, DIAMOND US addresses some non-kinetic issues and adequately addresses kinetic issues. However, the model was designed to accommodate a medium sized problem such as Sierra Leone or Liberia and is incapable of handling large problems due to software limitations. There are no current models at the campaign level available to analysts that adequately examine both kinetic and non-kinetic issues. The commercial wargame derivative could be used to assist a seminar wargame, but is unable to stand on its own due to aggregation and other issues. US Army CAA’s ERIS campaign model, when it is complete, may provide the needed functionality to address unconventional warfare and counter insurgency issues.

One promising model that addresses both kinetic and non kinetic issues is PSOM. However, it is also used to inform seminar wargames and is not yet ready for field use. In the non-kinetic arenas of Information Warfare and Psychological Operations, a number of potential tools are available. A number of agent based models could be used to examine these issues but suffers from formal accreditation issues. SOFBAT has a high potential but relies upon yet to be determined information operations JMEM like information.

There are several caveats. Other than JCATs, almost all of these models have never been used in a formal DoD mandated study addressing irregular warfare issues. As a result, the applicability of these models to this problem area may be less than initially perceived. The OOTW tool box (comprised of Pythagoras, ISSM, and DIAMOND US) has been applied to J8 WAD's ESS study effort. The remaining tools provide potential approaches to irregular warfare analysis. Most PMESII oriented models are prototypes (MIT Systems Dynamics Model, Agile, Commercial Wargame Derivative/IRIS-COINS) or have been applied as COCOM decision making aids (e.g. SEAS, IBC). Some tools are dedicated to GWOT issues e.g. IGS/EBW. SIAM was applied to an exploratory study issue, but has not been used for the formal analysis of irregular warfare issues. As mentioned, SOFBAT has not been used due to a lack of data. Only DIAMOND has been used to size UK peace support operations. Others are at various stages in the development process e.g. PSOM in final testing; ERIS in design. A Force More Powerful has just been released for sale.

## WG 1 - What Needs to be Done”



- **Frameworks/paradigms for Irregular Warfare Analysis**
- **Irregular Warfare M&S Evaluation Criteria**
- **Test Cases**
- **Irregular Warfare Scenarios**
- **MOEs**
- **Data**
- **Irregular Warfare M&S at the Campaign Level**
- **VV&A**
- **Analyst (and Consumer?) training**
- **Prototype cross-cutting studies**
- **Best of breed approach to model improvement**

The examination of the wide range of possible models produced several issues with respect to how the models could be used, evaluated, or evolved. However, the problem must be addressed as an entire system of analysts, frameworks, methodologies, test cases, scenarios, evaluation criteria, data and MOEs, and not just one of modeling and simulation tools.

The problem in analyzing irregular warfare issues are usually limited by the lack of an analytical framework or paradigm by which to analyze complex phenomena. The lack of a tool or several tools is less important than understanding the phenomena to be analyzed. Direct action and strategic reconnaissance issues are essentially traditional combat and are very well understood. As mentioned, insurgency and counter insurgency issues are only 20% military and 80% other PMESII variables. Fortunately, O'Neill, SWORD, and May and Neustadt provide frameworks for analyzing these problems. Distributed operations, shaping, information operations, and possibly GWOT are less fortunate in this respect.

Traditional criteria for evaluating combat simulations deal with internal validity, usability, adaptability, and replication of results (Robert Axelrod “Advancing the Art of Simulation in Social Sciences” 1997). Although these criteria also apply to irregular warfare models, there may be other criteria that should be uniquely applied to this class of models to evaluate whether one model is better than another.

The curriculum used to train military operations research analysts may have to be re-examined. To make the best use of the techniques provided by other disciplines, military OR analysts may have to receive training in quantitative social science methods. Perhaps an overview of historical analysis methodologies would also be useful.

This examination of model goodness is hampered by a lack of scenarios and studies against which to apply these tools. As mentioned previously, only ESS has examined the applicability of these tools against a specific scenario.

Additional prototype, cross-organizational studies should be undertaken to evaluate the existing list of tools based upon approved scenarios provided under the analytical agenda process. At present, there are few analytical agenda scenarios that cover the depth and breadth of irregular warfare. These studies would also reinforce a best of breed model development practice to achieve better models to address issues in the irregular warfare arena.

There are multiple technologies that may be of assistance in examining irregular warfare including, but not limited to agent based models, systems dynamics, and quantitative computational social sciences. Which application of one or more of these techniques to irregular warfare problems will produce the best answer is not clear. Hence a best of breed approach is needed to develop better models, especially at the campaign level of analysis. The DoD should fund several different approaches, potentially building on the preliminary DARPA efforts. Various tools should be trialed in prototype studies and the results should be fed back into the tool development process.

## WG 1 - New Stuff

- **Games as tools**
  - ◆ What makes a game helpful?
  - ◆ Scenario-based planning, seminar wargames, MMOGs?
- **Learn from other communities**
  - ◆ Computational social science
  - ◆ Commercial
    - Interface
    - Usability, flexibility, agility
    - Focus
- **Data mining tools**
  - ◆ Figure out what they're good for

While we didn't identify any "golden BB's" in the working group, several concepts did come up.

First, while games have been used by the military for many years to consider various issues, we thought that games and, broadly, gaming techniques, might be better able to address some of the issues that come up in dealing with populations and human factors. By "games" we mean wargames, to include scenario-based planning, seminar wargames, conventional wargames, and commercial games. We feel there is research needed to determine what the applicability is of various gaming techniques to the problems we were considering.

Second, we heard a lot from the computational science community. It is a community that has wrestled with these problems for many years, and has developed theoretical and practical approaches to these issues. In talking to members of this community during the WG session, it became apparent that we may need to listen more than we talk, in order to understand their practices and capabilities from their perspective, not ours as operations researchers or physical scientists.

Another community identified that we may learn something from is private industry. Companies use games, models, and simulations as tools, but they may use them in different ways. The interfaces may be different, the way they are procured, built, and evaluated may be different, and the focus of the design may differ from DoD products. Understanding what these differences are, and whether they could be incorporated into DoD practices may be a useful area of enquiry.

Finally, we heard from at least one model that used data mining as a way to develop its input database. It would mine the internet for various items, then accumulate them in a database to be used in a simulation. Data mining is not new, and there are many data mining systems available. It may be worth exploring the wide range of ways that data mining might be used to address these issues.

## WG 1 - A Few Suggestions



- **Change in the *consumption* of the analysis may be the “killer app”**
  - ◆ Develop ways to deal with uncertainty in the inputs and results
  - ◆ Develop ways to account for and balance risk involved in different experimental approaches and outcomes
- **Consider expanding the role of wargames as tools that support decision making**
  - ◆ But they have to be done right
  - ◆ And you have to balance them with models
- **Learn to use range of outcomes provided by multiple independent analytical approaches**

In addition to recommendations, and new ideas for tools, we tried to highlight the key points and issues we came up with. There were three:

1. Changing the way analysis is consumed may be the most important and cheapest to implement insight we can provide from this working group. It may also be the hardest to implement. It would require that consumers of analysis develop ways to deal with uncertainty in the inputs and results. It would also require that the analyses be conducted in ways that balance risk, and develop multiple possible experimental approaches and outcomes. This is something that may be worth discussing among analysts and analysis consumers. What level of uncertainty is too much in the results? How do you make decisions using outcome landscapes instead of single instance solutions?
2. One topic that came up repeatedly in the meeting was the subject of expanding the role of wargames as ways to support decision making. Simulations, particularly simulations used to help frame and focus procurement decisions, play both an analytical and a socialization role within the decision making process. For topics that do not lend themselves to simulation or modeling, games might play a more substantial role in that decision making socialization process.
3. Another recurring topic was the need to have a range of theories, models, methodologies, and outcomes available when assessing a particular problem related to human factors. We were briefed on a recent DARPA effort that involved multiple competing models that examined government stability. The results of examining the landscape of model solutions provided greater insight than that of an individual model. This concept, of using multiple, different approaches to address the same problem was felt to be more appropriate for these problems than the use of one, individual model or approach.

## WG 1 - Recommendations



- **Getting the question and the framework right is important - and relatively inexpensive**
  - ◆ But it can take time, and iteration
- **Examine the possibility of collecting real-world data to support decisions**
- **Examine groups of models**
- **Research the use of games/scenario planning/commercial techniques to support decision making**

The WG recommendations are contained on this slide and the next. They summarize what has come before and expand on these concepts.

While getting the question right is important, it is also important to acknowledge that it can take time and involve the sponsors in an iterative process.

There is a need for real-world data to support analysis and modeling. It may be useful to examine the various impediments to collecting this data including legal, programmatic, and other issues.

As we mentioned, examining an ensemble of models may be important to give decision makers a landscape of solutions.

Finally, it may be fruitful to examine various wargaming and commercial techniques as they apply to addressing these problems.

While we did not find answers to the problems we were presented with, we believe we have identified some specific actions that could be taken.

## WG 1 - Recommendations

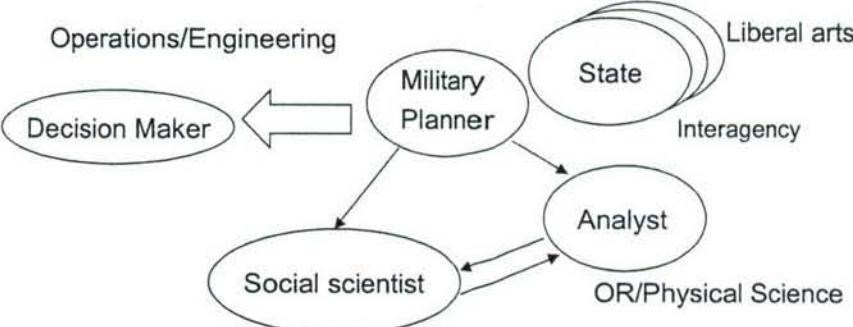


- **Examine new ways to validate models, and find ways to deal with what traditionally cannot be validated**
  - ◆ Any model that deals with human decision making
  - ◆ While they cannot be validated they can be used to inform and support decision making
  - ◆ Traditional assumptions of reproducibility and traceability may need to be replaced with transparency and acceptance of judgment
- **Examine thinking about the role of modeling, and the need for scientific answers for questions that may have no basis in physical science**
  - ◆ May need to accept more risk in this area

One topic that was discussed throughout the working group was the question of how models and other techniques should be validated. It may be that traditional methods used for validation may not apply to the issues discussed in this working group. We need to work to understand what can and cannot be validated and what can be used even though it cannot be validated through the traditional mechanisms. Finally, it may be important to examine traditional assumptions about reproducibility and traceability that are required for valid operational analysis when considering subjects like human behavior, population dynamics, and other soft questions.

Ultimately the question of validation comes down to the role of the decision maker and the degree of risk they are willing to assume in making a decision based on information that is not reproducible or scientific in the physical sciences sense. In the discussions that went on in the working group, it became apparent that many of the questions that decision makers may ask may not be answerable through traditional operations research techniques. The challenge may be to develop new ways of dealing with that reality — ways that still provide a robust, rigorous, and credible ability to answer the questions.

## SWG 1-1 — Worlds Collide



- ◆ What are the right ingredients to turn the social science into a campaign level analysis?
- ◆ Each is uncomfortable in the others world
- ◆ Need to begin to merge disciplines

Sub-Working Group One (SWG 1-1) was asked to examine the ability of analysis and models to guide an influence campaign designed to discourage popular support for an irregular force, and deter the force itself.

One realization that came out of that group was that there are different worlds that deal with different aspects of the military planner's problem. The analyst exists in the operations research/physical science world. With that comes a world-view and concept of analysis that can sometimes be at odds with the view of the social scientist. Similarly, the interagency is often composed of individuals who comes from a different background, in political science, for example. The military planner and decision makers also come from an operations and often an engineering background. In dealing with irregular warfare issues, however, it will be important for all of these different worlds to work together toward a common understanding of how to approach and analyze the problem. The feeling in this sub-working group is that as all of these different entities begin to work together toward a common understanding of the problem, analysis, and tools — the fields will also need to begin to work together collaboratively.

## **I CAN'T STAND THIS**



**Scenario:** Kazakhstan, radical Islamic insurgents, Russians on the ground with a heavy hand on the local population

**Objective:** Work with Russian counterparts to develop coordinated elements of a public diplomacy, information operations and TSC campaign to thwart burgeoning spread of radical Islam to the Kazakhstans

The first sub-working group to brief out was asked to examine a complex scenario involving Kazakhstan and a radical Islamic insurgency. The key objective for the group was to identify how analysis could support the COCOM in developing a plan for public diplomacy, information operations, and theater security cooperation.

## **I CAN'T STAND THIS**



**Customer:** COCOM, with potential diplomatic overlap

**Time Horizon:** Undefined, but not immediate

**Problem definition:** Provide analytic support to COCOM staff to help plan a variety of flexible deterrent options (FDOS) covering the growing radicalization of the Kazakhstans

**CPB:** Network of relationships, model – not simulation, political map, cultural map

This was the way the working group parsed the problem and the timeline.

Analysis was seen to be able to help with an understanding of the battlefield. This was termed Cultural Preparation of the Battlefield (CPB).

First the group wanted to identify the relationships between various individuals involved in the insurgency.

Then they wanted to develop a model, of the insurgency. This was not a model in the sense of a simulation, but rather a way to think about the relationships and cultural factors that went into the insurgency.

Finally they wanted to develop two maps that would describe the insurgency, a political map and a cultural map.

## ***I CAN'T STAND THIS***



**Wargame:** Transparency, communication, analytical challenge and alternative theories

**Assessment:** Polling, selected interviews

**Contingency:** Traditional models, CPB and wargame based assumptions

The sub-group felt that the best way to identify many of the issues involved in the scenario was through conventional wargaming. It would provide alternative theories of what courses of action to take, and be relatively transparent to those involved.

Assessing the courses of action would require polling and interviews of the population in order to establish ground truth data.

This effort could feed into planning for a military contingency operation, which, if needed, would benefit from the cultural preparation of the battlefield.

## C'EST LA VIE! - Hard Issues



- **Will the violence continue to escalate?**
  - ◆ Trend analysis of web text searches such as Blacklight; Public poll analysis could also be useful
- **Can we predict the population dynamics prior to mass insurgency**
  - ◆ Could gain insights into dense recruitment pools/areas by combining multiple data sets (age demographics, unemployment levels, crime rates, perceived inequalities, income levels, education levels, election results, culture)
    - Combine these data sets using map overlays or GIS tools to create visual recruitment landscape
    - Landscape could prove useful for Operation planning (Focus IO on dense populations of potential recruits)
- **Is it possible to model COIN in a Western nation?**
  - ◆ PSOM with changes (Increase resolution in urban areas)

This sub-working group was tasked with analyzing a Canadian scenario with an emergent insurgency in the province of Quebec.

They started off with what they thought were the hard issues, ones that did not have a clear analytical solutions path.

One thing they realized was that this scenario highlighted the difference in available data between an open, post-industrial nation such as Canada and less developed nations or ones that do not have as free expression as citizens of liberal democracies. In this scenario the group felt that data mining tools would be important, including the Blacklight tool the group had been briefed on during the plenary session. Likewise polling and other data would be both available and more reliable.

When combined with demographic data, the group felt that a data landscape could be created using GIS or other tools that would provide operational planning capabilities, whether for IO or to identify areas of potential unrest.

One tool that was briefed to the plenary session that this group felt would be useful was the PSOM tool. With changes it could be used to possibly model COIN operations. The changes would involve decreasing the size of the calculated grid squares so that the higher population density of an urban area could be assessed.

## C'EST LA VIE! - Less Hard Issues



- **Are there models of border flows**
  - ◆ Traffic, transportation and immigration authorities could potentially provide insights/models
  - ◆ Terrain analysis could also be very useful
- **What aid could the US provide if asked?**
  - ◆ Waterway and critical infrastructure protection
    - Modeled using conventional Kinetic models and network models of the power grid
  - ◆ Border protection and arms interdiction
    - ISR Models, Kinetic models
- **Historical models of Ireland, Kosovo, and 1980 Quebec insurgencies could prove useful**

These are the group of issues that the sub working group decided could be handled by existing models or simulations. The issues included modeling or accounting for possible cross border flows of people or weapons. Here existing models from other agencies might be pulled into the analysis. US aid to Canada could be assessed by using straightforward military models that draw on conventional kinetic or ISR models.

Finally, the group felt that historical models of past insurgencies might prove useful in guiding the development of courses of action. The use of historical data to assist in model validation, or in providing insights into insurgencies, was a theme that recurred throughout the working group.

## C'EST LA VIE! - Insights



- **Modeling COIN in Western nations is significantly different than doing so in other areas**
  - ◆ Availability and credibility of data allows for better analysis of current news sources
- **True simulations seem to fall short, but there exists value in methodologies that combine relatively simple algorithms with strong data resultant of free speech**
- **Multiple tools that provide varying insights are more valuable than the search for one tool that claims to determine an optimal solution**
- **US action could potentially free Canadian forces for use on operations where they possess a competitive advantage (OPS requiring local knowledge; Troops in the streets)**
  - ◆ This could allow the US to maintain a low profile and prevent potential Canadian civilian backlash

This group identified two key themes that relate to our findings from the plenary sessions:

1. Data availability can provide additional ability to model, and do analysis, when it's available. Because a larger set of demographic, cultural, and informational data was available in this scenario, a wider range of analytical tools and techniques could be tried. And those techniques would also have a better chance of accurately reflecting reality.
2. The use of multiple tools would provide the commander the ability to evaluate a wide range of theories and principles in making decisions, instead of trying to identify one, optimal solution. For insurgencies, such a solution might not be capable of being identified through traditional operations research analysis.

## Other Insights and Random Thoughts



- DARPA PCAS program seems promising
  - ◆ There is a concern that the program is terminating or receiving a low level of funding
- Use of low-complexity vs. high-complexity modeling in DoD
  - ◆ Are we using high-definition modeling because we have them and know how to run them, instead of directing analyses toward the tough issues DoD decision makers face
  - ◆ Cease and desist! Set our analytical talent on addressing the key issues and let them figure out how to do it
- Are we tapping the vast world of analysis of social science phenomena in academia and business? When we do, can the techniques that we find create useable tools for our decision makers?
- Should the analytic community shift some of its resources toward problem definition?
  - ◆ Many questions may be amenable to qualitative analysis and/or simple analytic techniques vice complex modeling
- Is MORS the problem? Is our discipline built too much around classical OR (the WW-II legacy)? Need more analysts to be trained in Social Science modeling. Find ways to bring the work that is being done into the decision- and policy-making levels. Tap into fields like anthropology that are not well-represented in our analytical community.
- We ought to be doing OA studies at the inter-agency level. Encourage MORS participation by non-DoD agencies

The last working group featured in the briefing was asked to examine military operations in urban terrain (MOUT). We included their last slide as the last slide in the briefing because it emphasizes some points that have already been made:

- Using multiple models as was done in the DARPA PCAS project to develop solution landscapes. One way to do that is to develop many low-definition models instead of a small number of high-definition models
- Involving the social sciences in helping develop our analytical tools.
- Examine the problem of defining what the problem is. Perhaps additional work is needed in understanding exactly what is being asked of the OR community.

This group also, however, identified several other, important, insights into the problem of analyzing irregular warfare:

- Throughout the conference the role of interagency participation was discussed, but never examined in detail. Analysis of interagency-related issues and problems could be a major conference by itself.
- Is MORS the problem? Should we open the field of operations research to a broader and more diverse group of individuals who can bring techniques and talents that we currently do not have available?

## Backup



## WG 1 - Charter and Approach



- **GWOT and Irregular Warfare**

- **GWOT and Irregular Warfare**
  - ◆ A large set of topics
  - ◆ The largest session (80 people)

- **Approach**

- **Approach**
  - ◆ Baseline with stakeholders
  - ◆ Critically examine existing models
  - ◆ Search for new ideas in the best places
    - Academia, FFRDC's, gamers
  - ◆ Involve everyone in small groups
    - Using a scenario-based approach
  - ◆ We have interesting speakers, plan to introduce stimulating ideas

## Details

- **Baseline participants**

- ◆ Session overview, common set of questions
- ◆ How do we account for what we currently don't account for?

- **Scenarios**

- ◆ Designed to stimulate discussion, provide interest
- ◆ Will be facilitated discussion
- ◆ 10 Scenarios - will modify according to number of participants to keep 7-10 people/group
- ◆ Scenarios range from planning and resourcing to execution
- ◆ All are focused on addressing the hard problems

## WG 1 - Final Schedule



- Day 1: Stakeholder Briefings and Round Table
  - ◆ OSD PA&E *Mr. Preston Dunlap*
  - ◆ US Army *No Representative*
  - ◆ US Navy *Captain Andy King*
  - ◆ US Marine Corps *Mr. Steve Stephens*
  - ◆ US Air Force *No Representative*
  - ◆ SOCOM *Mr. Ed Cardenas*
  - ◆ EUCOM *No Representative*
  - ◆ CENTCOM *No Representative*
- Day 2:
  - ◆ DoD Large-Scale Model Briefings and Roundtable
    - *Larry Budge* *Alion* *SEAS*
    - *Ed Cardenas* *NG/SOCOM* *SOFBAT*
    - *Tom Couture* *Group W* *MOOTW FAST Toolbox (ISSM, JCATS, Diamond US)*
    - *Nicola Stewart* *UK MOD* *PSOM Peace Support Operations Model*
    - *John Shepherd* *US Army CAA* *ERIS (JOES CI)*
    - *Larry Budge* *Alion* *The Sentient World*
  - ◆ Novel Approaches Briefings and Roundtable
    - *Mr. Martin Lidy* *IDA* *Interdepartmental Analytical Framework*
    - *Dr. Robert Popp* *DARPA* *Quantitative Computational Social Sciences*
    - *Douglas Whatley* *Breakaway* *A Force More Powerful*
    - *Mr Aaron Frank* *BAE* *Quantitative Computational Social Sciences*
    - *Ken Comer* *OSD PA&E* *VV&A: Agent Based Models*
    - *Dr. Alok Chataverdi* *SIMULEX* *VV&A: Agent Based Models*

## WG 1 - Draft Schedule (Concluded)



- Day 2:
  - ◆ Sub Working Group Scenario Discussions during Lunch
    - Dr. Ed McGrady CNA 1. Economics 101
    - Mr. Ed Cardenas SOCOM 2. Up the River
    - Dr. Cy Stanic NG 3. You Must Be On Drugs
    - Mr. Steve Stephens USMC 4. I Can't Stand This
    - LTC Steve Knight J8 WAD 5. I Wanna go back to the Islands
    - CMDR Tom McNeerney USN 6. Pirates are Cool
    - Mr. John Collier OSD PA&E 7. C'est La Vie!
    - Mr. Mike Williams OSD PA&E 8. A Dispute of Long Standing
    - Mike Ottenberg OSD PA&E 9. A Place in the Sun
    - Mr. John Snewely OSD PA&E 10. MOUT + Terrorists =?
    - Mr. Mike Fitzsimmons IDA
    - Dr. Royce Kneecce IDA
- Day 3:
  - ◆ Core focus out-brief prepared
  - ◆ Working groups prepare out-briefs on scenarios



# Analysis for Non-Traditional Security Challenges: Methods & Tools

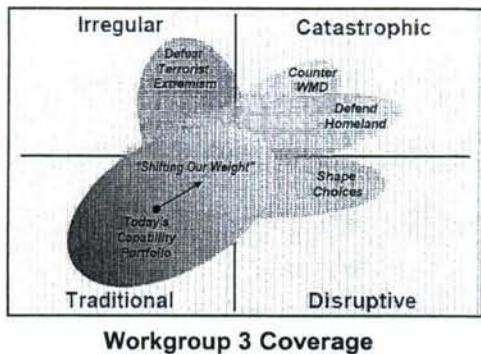
**Military Operations Research Society  
(MORS) Workshop**

## **WG 3 - Catastrophic Outbrief**

### **WG 3 Participants**

Adams, LTC/P Joseph	USNORTHCOM Analysis Directorate
Boon, Mr Jacob E.	JHU/APL
Borsi, Dr John J.	HQ USAF/A9
Byers, Dr Mark E.	DTRA
Clements, Mr Donald W.	SAIC
Dixon, Dr Lisa A	OSD/PA&E/Simulation & Analysis Center
Edwards, Ms Kimberly	Joint Requirements Office
Goodwin, Mr David P.	U.S. Department of Energy
Griffith, 2LT Paul A	HQ USAF/A9 (A9AW)
Heady, Col Samuel C.	OASD - Homeland Defense
Hudson, Mr Fred S	Cubic Defense Applications
Ihde, Mr Alexander G	JHU/APL
Juge, Dr Matthew	Lockheed Martin Missiles and Fire Control -
LaRiviere, Mr Richard M.	Data Research & Analysis Corp (HQ)
Leonardis, Mr John	Northrop Grumman
Mahin, Mr Derek A.	SRA International
Morin, Mr Charles L.	Computer Sciences Corporation
Pestone, Mr Victor J.	SAIC
Pigeon, Dr Luc	Defence R&D Canada
Plourde, 1LT Jennifer R.	AFRL/HEPC
Seise, LTC Alan	Center for Strategic Leadership, USAWC
Sweetser, Dr Wilmer A. Jr	OSD/PA&E/SAC
Waikus, Mr Alan J.	Defense Threat Reduction Agency
Weinberg, Mr Edward L.	OSD PA&E JDS (Contractor)
Wright, Mr Steven J.	National Guard Bureau
Zimmers, Mr Walter H.	Defense Threat Reduction Agency

## WG 3: Overview



### Workgroup 3 Coverage

- ◆ Accelerate existing programs focused on engineering → tactical model integration ... Not ready to build new operational or strategic models: focus on data collection from exercises, operations and war games
- ◆ Conduct analytically supported war games to clarify roles, concepts, CONOPS, and metrics to better refine needs
- ◆ Facilitate or inter-agency analytical Community of Interest (COI)
- ◆ **HLD imperative: Born joint → Born interagency/international**



HLD: State of data, methods, tools

WG 3 (Catastrophic) did well assessing the status of analysis and M&S for homeland defense (particularly consequence management), but less so for counter WMD.

Per the Model Hierarchy, the community appears to have a large collection of data, methods, and tools in use for engineering and systems levels and a few at the mission and tactical levels, but there are almost no applications at the operational or strategic levels. In other words, there is no single application that can be used to model the homeland defense or counter WMD campaign.

Current tool and method development is focusing on integrating the existing tools to better support mission and tactical level analytical questions, especially to support quick-turn response for COCOMs and future first-responders.

For analysis at the operational and strategic level, the community is not yet ready to define the new methods or tools that are needed; instead, the focus is on data collection from exercises, operations and war games to better understand the models that are needed. Data may be collected through data mining or participation in wargames.

Focal activity will be analytical support of wargames so that:

- A complex set of interagency roles and capabilities can be identified and clarified
- A best practice CONOPS of all role players can be identified (first responders, local governments, US states/National Guard, DHS/FEMA, EPA, CDC/NIH, DoD)
- A Metrics of success can be developed (e.g., time to respond, lives saved, etc.)

A key way ahead for the WG is to develop a robust COI to keep DoD participants aware of all DoD activities but also as a way to collaborate and coordinate with other agencies on a routine, action level basis; COIs might use a website/blog forum to facilitate the exchange of ideas or documents

Homeland Defense analysis can not be done well without extensive non-DoD participation, therefore all HLD activities must be born interagency/international.

## WG 3: Strategic Challenges



- **Catastrophic homeland events: Man-made or naturally occurring events involving significant loss of life and significant social/political/economic/psychological effects: e.g. large National Planning Scenarios (10KT nuke, chlorine tank, plague, anthrax, large natural disasters)**
  - ◆ COI: NORTHCOM, PACOM, Services, DTRA, National Labs, DHS (includes Coast Guard, FEMA), HSC, EPA, DOE
- **Counter-WMD: Events involving WMD interdiction, counter-proliferation, deter/defeat the use of WMD by state and non-state actors**
  - ◆ COI: STRATCOM, Services, Regional COCOMS, DTRA, National Labs, DOE
- **Significance = *f*(physical, economic, social, political and psychological effects, level of effort, duration)**
- **Some key unresolved issues**
  - ◆ Roles and relationships (Lead Federal Agency, Title 10/32, authority)
  - ◆ Lack of coordination, integration, inter-operability
  - ◆ Immature data, methods, tools in some areas

The first issue we had to decide upon was what constitutes a catastrophic event. Our first cut at this was to examine the 15 National Planning Scenarios developed by the Homeland Security Council and DHS. From these 15 scenarios, there are several that involve significant loss of life and/or significant social, political, economic, or psychological effects. These scenarios are listed and would probably necessitate a DoD response.

The second catastrophic area is counter WMD and our definition of this area is shown above. We feel that the COI for this area is a bit more restricted than the homeland defense area.

Regardless of which of the two major areas you are examining, determining the level of significance of the event can be defined as a function of the factors shown. In our discussions, we recognized that the political and psychological factors may be dependent on current events. In other words, events that occurred before 9-11 that were not considered catastrophic at that time may now be considered catastrophic when viewed through the lens of 9-11.

In our view, there are still some thorny unresolved issues. These issues generally fall into the three broad categories: 1) roles and relationships; 2) coordination, integration and interoperations; and, 3) immature data, methods and tools in some areas.

## WG 3: Current Analytic and M&S Capabilities



- **Current capabilities**

- ◆ Engineering level: Robust individual models: DTRA Suite, CAPS
- ◆ Tactical/operational level: EPICS, JCATS, IWMDT
- ◆ Campaign level: Legacy models (ITEM), but these are not tailored for domestic catastrophic events
- ◆ Training models: Significant lack of simulators, stimulators, and facilities

- **Applications/examples – many stand alone tools. Multiple tools are often required to assess a scenario**

- ◆ Defense Collaboration Tool Suite/InfoWorkSpace (DCTS/IWS)
- ◆ Hazard Prediction Assessment Capability (HPAC)
- ◆ Consequence Assessment Toolset (CATS)
- ◆ Integrated Munitions Effects Assessment (IMEA)
- ◆ Vulnerability Assessment and Protection Option (VAPO)
- ◆ Traditional campaign analysis/mission level tools re-purposed to assess catastrophic scenarios

The majority of the current M&S tools and capabilities generally fall into the engineering and mission areas of the M&S pyramid although there are a few tools available at the tactical level. There is some effort being applied to use some of our legacy campaign models (such as ITEM) in the HLS/HLD arena, but these tools are generally not tailored for analysis of domestic catastrophic events.

The example applications shown above are just the tip of the iceberg with regard to our ability to model WMD effects. These tools are generally very good at modeling first order effects and the spread and/or transmission of those effects from the source through the target area. Generally, these tools are also stand-alone products, and therefore the results of one model/tool cannot directly feed the inputs of another model/tool.

## WG 3: On-going Enhancements to Analytic and M&S Capabilities



- **Selected engineering and system level tools**

- ◆ Joint Effects Model (JEM): Predict and track NBC and Toxic Industrial Chemical/Material (TIC/TIM) events and effects
- ◆ Joint Operational Effects Federation (JOEF): M&S for warfighters and planners to accurately predict CBRNE effects
- ◆ The Joint Warning and Reporting Network (JWARN): Comprehensive analysis and response capability to minimize the effects of NBC attacks, accidents and incidents

**DTRA will begin to spiral Integrated WMD Toolset (IWMDT) FY06**

- **DTRA Collaboration Center (DCC) - common architecture that supports CBRNE data fusion from disparate sources supporting Situational Awareness, Systems Engineering and capability development: initial operational capability FY06**

**DTRA partnering with Services, COCOMS, Allies, Labs**

DTRA is currently involved in enhancing several of the M&S tools to better support their warfighter customer. These tools will become part of the IWMDT and will be available through a reachback function centered on the DTRA Collaboration Center.

## WG 3: Analysis Gaps and Deficiencies



### • Key stakeholders and decision makers

- ◆ USG (Inter-agency)
- ◆ Allies
- ◆ State/Territorial Governments/NG
- ◆ DoD/Services/COCOMS
- ◆ Coalitions
- ◆ National/private labs
- ◆ Local Governments
- ◆ Industry
- ◆ First responders

### • Key analysis gaps and deficiencies

- ◆ Perceived lack of objective goals, defined responsibilities, actions/resources reflecting stated priorities
- ◆ Need for improved interagency cooperation, collaboration, and data sharing
- ◆ Insufficient understanding of complex, primary effects and secondary effects (political, economic, social, psychological)
- ◆ Little quantification of local, state, federal, DoD, and international response capabilities
- ◆ Immature and/or non-existent operating procedures, data, tools for evolving mission and requirements
- ◆ Barriers to sharing data, plans (classification issues, terminology, ontology)

### • Commonalities between stakeholders

- ◆ Desire for comprehensive, systematic, interagency analysis
- ◆ Desire for integrated, tactical/operational tools
- ◆ Need to plan for response and future investments
- ◆ Mission focus

To address the list of gaps shown, the analysis work needs to be coordinated among or draw data from all stakeholders, because the plans/CONOPS for each stakeholder will be influenced or dependent on that of the other stakeholders. Any analysis to attempt to optimize planning, investments, or support tools for consequence management will be inaccurate unless these stakeholder interdependencies are captured in the modeling/analysis.

The perceived lack of priority listed as a gap is not an indication that anyone has said that HLD is not important, but that **other** priorities have let roadblocks to effective HLD analysis (e.g., natural tendency toward stove-piped activity) remain unresolved.

The lack of clear goals is due to: 1) a lack of understanding about what each stakeholder can reasonably hope to achieve; and, 2) unfamiliarity with the comprehensive and complex effects of a catastrophic event, e.g., don't understand all the effects that have to be managed (economic, political etc.).

Analytical support of and participation in exercises and wargames appears to be the best starting point for eliciting the data that will clarify stakeholder roles and capabilities for HLD.

Analytical exercises/wargames should also help stakeholders improve on the immature requirements and plans for the HLD vice the military theater mission. The key issue is that the DoD has typically had a passive role in HLD/consequence management, i.e., provide what is available when calls for help come in. However, based on the DoDs expertise in systematic planning for rapid response and use of iterative exercises, wargames, modeling, and simulation to develop and refine response plans, capabilities, and program investments, the DoD needs to step up to support the larger interagency community in developing the HLD response plans, even though the DoD will likely always start in a supporting role in any catastrophic scenario and will not be able to dictate a complete response plan.

Breaking down barriers between analysis communities within the DoD and between agencies will be facilitated by a standard data format and by methods for navigating around classified data.

The list of commonalities among the entire set of stakeholders — across all agencies — reflects universal concern about catastrophic scenarios. There also is strong consensus that no stakeholder can go it alone; Hurricane Katrina re-emphasized that we are not ready to address no-warning scenarios and that a way around and through traditional stovepipes must be found and cultivated as soon as possible.

## WG 3: Key M&S Shortfalls and Gaps



### • Data

- ◆ Lack of data on local, state, other federal, NGO, int'l agency capability
- ◆ Biological threats, retransmission, mortality, etc.
- ◆ CBRN effects (lack of current/empirical test data)

### • CONOPS

- ◆ Desired response over time
- ◆ Metrics
- ◆ Translation of DoD capabilities to HLD employment
  - Pre-event (detect, deter, prevent capabilities)
  - Post-event (consequence management)
- ◆ Apportionment of tasks across services

### • Methods/Tools

- ◆ Model integration/synergy (output of one model not always useable by others to provide useful/meaningful output)
- ◆ Catastrophic models (e.g. Biological)
- ◆ Empirical based models
- ◆ Socio-economical, psychological, and political aspects
- ◆ Integrated M&S "pyramid," particularly at higher levels

The M&S shortfalls and gaps we have identified can be summarized in three areas — data, CONOPS, and methods/tools. With regard to the gaps in the data area, we see three major deficiencies:

1. The lack of data concerning the capabilities of the local, state, other federal, NGOs, and international agencies. It is extremely difficult to predict what capabilities will be requested from DoD in response to a catastrophic event when we have no idea of what portions of the response activities can be handled before DoD is requested to enter the fight.
2. Although there are many tools to examine CBRN effects at the engineering or systems level, tools in the bio area are generally lacking. This is especially true concerning some of the newer, engineered biological threats and with the retransmission or secondary infections from the agent.
3. Lastly, it must be recognized that there is a lack of current empirical test data available to test our models/tools against. For example, in the nuclear arena, the last open air nuclear test was conducted in 1962 and the test data collected in that and previous tests did not have the fidelity that we would want to collect today.

With regard to CONOPS, the key shortfalls are highlighted. While there has been some effort to determine what capabilities/tasks are required in response to a catastrophic event, there has been no real effort to determine how these responses need to be time-phased. As alluded to earlier, the majority of the tools that support the catastrophic area are effects related and are therefore related to consequence management. There is a distinct lack of effort concerning analysis of pre-event capabilities. This may be related to the lack of appropriate metrics in this area. For example, how do you measure success with regard to preventing or deterring a WMD event?

With regard to methods and tools, we've already mentioned our concerns about how the results from one model are not directly usable as inputs to another model and our concerns regarding biological event modeling. We also have concerns that there are large gaps in our tools to examine the socio-economical, psychological, and political effects and that there is really no tools at the higher end of the M&S pyramid.

## WG 3: Potential Solutions



### • Data/CONOPS

- ◆ DHS development of a database of state and local capabilities (Target Capabilities List)
- ◆ Establish proponents for interagency data collection for engineering to campaign level analyses
- ◆ Development/assessment of appropriate Analytic Agenda scenarios and baselines
- ◆ Leverage JFCOM Experimentation, Joint Training, and Joint Center for Operational Analysis events/processes for:
  - Development of Combating WMD/"Catastrophic" analytical tools/methods
  - Relevant data (e.g., Joint Rapid Distributed Database Development – JRD3)
  - Potential M&S/analytical solutions/needs derived through experimentation

### • Methods/Tools

- ◆ Facilitated war games (EPICS – Emergency Preparedness Incident Command Simulation, JSRTS - Joint State Response Training Simulation, TOPOFF)
- ◆ DTRA's fielding of an integrated GIG-accessible suite of CBRNE tools
- ◆ Enhancements to campaign models (ITEM to link IWMDT)
- ◆ Commercial game adaptations/gaming engines (e.g. SimCity, Delta3D)
- ◆ Potential partnerships for new M&S/data development: DTRA, DHS (including Coast Guard, FEMA), National Guard Bureau, JFCOM, NORTHCOM, STRATCOM, UK, Canada, Service labs (AFRL), industry

From the DoD's perspective, potential solutions involve leveraging the expertise and work to date of other major stakeholders who can provide a first cut at quantifying the local response; DHS has the federal lead and is the federal gatekeeper in interactions between federal and local/state planners and is part way thru a national, comprehensive assessment of local abilities compared to 37 Target Capabilities (data is expected in the second half of '06); the NGB has been conducting a similar assessment based on State Guard plans for selected National Planning Scenarios (States with at least one of 50 most populous cities had to select NPS 1).

Interagency data is difficult to collect and difficult to maintain and manage. PA&E/JDS can and will manage data from official scenarios and programs of record based on the analytic agenda, but does not manage unofficial data. Identifying other proponents to maintain this unofficial set of data will be important.

More aspects of homeland defense and combating WMD as scenarios in the analytical agenda must be established so more data will be captured and managed by PA&E/JDS.

JFCOM's listed activities have the potential to generate data and possible CONOPs to support HLD analyses (consequence management and Combating WMD), both as examples of what the DoD would do in a response scenario and what strategies could be translated into options for non-DoD best practices. As JFCOM is a major customer for DTRA's simulation and analysis tools, there is an established relationship with the analytic community that could be exploited through additional analytical support of exercises, wargames or data-mining.

There are no simple tool solutions for the analysis of catastrophic scenarios. To re-iterate, the WG agreed that the community needs to look around for new tool/modeling/analysis ideas and concepts. Partnerships between the listed stakeholders also need to be developed.

## WG 3: High Priority Analytic M&S Needs



### Focus on data and establishing an M&S Community of Interest

#### • Data

- ◆ Establish a list of questions for catastrophic events requiring analysis (esp. COCOM needs)
- ◆ Collect exercise and operational data: Unit commitment, deployment timeline, activities, duration of commitment
- ◆ Collect war game results: C2 relationships, roles, CONOPS, metrics, need for DoD forces, Title 10/32 relationships
- ◆ Begin to re-validate applicability of basic engineering data (lab testing for CBRNE)
- ◆ Develop Biological warfare/contagious disease data: Retransmission, morbidity, etc.
- ◆ Follow up on DHS efforts to develop systematic, comprehensive development of data on local/state response capability
- ◆ Support common data standards (metadata)

#### • Methods

- ◆ Increased catastrophic scenario involvement in analytical agenda products
- ◆ Support the conduct of facilitated war games to develop CONOPS, concepts, metrics and clarify responsibilities
- ◆ Support SPG tasker to assess large consequence management events

#### • Tools

- ◆ Assess DTRA Collaboration Center ability to support analytical requirements
- ◆ Establish an interagency HLD M&S COI to refine requirements and integrate effort

Once again, the WG summarized what it see as the M&S needs into three general areas ... data, methods, and tools.

The first major theme with regard to data needs is the requirement to collect a list of questions from the COCOMs to identify what they see as the major analysis needs concerning catastrophic events. The second major theme is the need to collect data from operational tests, exercises, and wargames in order to test models being developed and to serve as a measuring stick against which we can compare results from current models. The third major theme is to follow up with DHS efforts to develop data on local, state, and other federal response capabilities. Lastly, there is a need to develop common data standards that can facilitate the development of metadata in order to standardize data collection in the future.

With regard to methods, the primary issue here is support of the analytical agenda and the expected tasking from the SPG.

## WG 3: Recommendations



### • Specific to WG area

- ◆ Develop databases and sources for that data
- ◆ Conduct analytically supported exercises, war games, and studies to refine CONOPS, metrics
- ◆ Develop an active and robust interagency M&S Community of Interest
- ◆ Consider redefining "Catastrophic" as two missions areas:
  - Pre-event (prevent, deter, defeat)
  - Post-event (consequence management)

### • Overall to Non-Traditional Challenges

- ◆ Improve communications between all stakeholders by increased focus on Non-traditional challenges in MORS, JCAC, and other joint and inter-agency forums
- ◆ Develop M&S Communities of Interest for each of the sub-areas
- ◆ Reapportion M&S funding from traditional to non-traditional models
- ◆ Renew emphasis on analytically supported war gaming
- ◆ Refocus the analytic agenda on non-traditional scenario development and analysis
- ◆ Data-mine DTOs, goals, objectives, and funding profiles

### • Other comments

- ◆ Need to support inter-agency participation
- ◆ Need to recognize that significant policy and legal issues remain unresolved
- ◆ If the next 9-11 or OIF stability operations happens, will we be able to say we've done our best to plan and prepare?

In our earlier slides, we noted that there is generally a lack of models and/or tools above the engineering or systems level. Before development of higher level models can proceed, we need to focus on developing good data and sources for that data. This may be facilitated by the establishment of a robust interagency community of interest in the catastrophic arena. We also see the need to redefine the catastrophic mission area into pre- and post- event areas. Current efforts seem to be focused on the post-event or consequence management actions, but we cannot afford to forget analysis focused on preventing or deterring catastrophic events.

In general we see the need for greatly increased interagency participation and that there are significant policy and legal issues that remain unresolved. In spite of these shortcomings, our efforts need to be focused on improving our analytical capabilities in the catastrophic arena. As we face ourselves in the mirror each day, our bottom line question ought to be have we done our best to respond to or to prevent the next 9-11 event.

## WG 3: Way Ahead



- DTRA develop paper on combating WMD for *PHALANX* to describe new missions and required supporting analysis – consider follow up meetings
- Provide this brief to Analytical M&S Master Plan conference (March 12-14)
- Participate in March MSFD conference, Newport, RI (combating WMD)
- Support "THOLIAN WEB"

Based on the pre-Workshop WG 3 Survey, there seemed to be a number of “voices crying out in the wilderness” in terms of what was going on in DOD and elsewhere and what tools and data are available for analysts’ use. As a result of the survey, DTRA gave two briefings to educate the WG on what DTRA can do/is doing and then the tools that DTRA makes available for use. To expand that education to the larger analytic community, a DTRA representative agreed to develop a paper for *PHALANX* to reiterate what was shared at Workshop.

To provide needed priority for HLD activities and therefore get the needed resource and participatory support for analyses, it will be important to pass the conclusions of the WG to the Analytical M&S Master Plan conference.

Similarly, the dialog and conclusions from the WG need to be inserted in the March MSFD conference in Newport, RI.

Finally, as a representative example of what the WG recommended in its Ways Forward, the analytical exercise, THOLIAN WEB, co-sponsored by PA&E/SAC and J8, needs the community’s support. This exercise will be a first iteration in PA&E’s ongoing attempts to define the DOD role and required forces for a Consequence Management/HLD scenario. THOLIAN WEB focuses specifically on National Planning Scenario #1 (10 kT IND).





# Analysis for Non-Traditional Security Challenges: Methods & Tools

**Military Operations Research Society  
(MORS) Workshop**

## **WG 4 - Deterrence Outbrief**

### **Working Group Participants**

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## WG 4 – Synopsis of the Concept



**Strategic Deterrence:** The prevention of adversary aggression or coercion that threatens *vital interests* of the United States and/or our national survival. Strategic deterrence *convinces* adversaries *not to take grievous courses of action by means of decisive influence over their decision making.*

### Ends

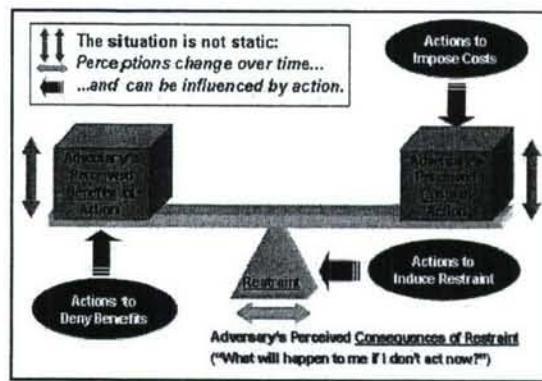
- Decisively influence
- Decision making calculus

### Ways

- Deny Benefits
- Impose Costs
- Induce Restraint

### Means

- Joint Force Capabilities (DoD)
- Elements of National Power (USG)



The Strategic Deterrence Joint Operating Concept (SD JOC) provides the conceptual basis for this working group. As with other non-traditional activities, deterrence is being redefined to more adequately address a broader set of conditions and adversaries. The SD JOC presents a concept that seeks to achieve decisive impact or influence over an adversary's (or potential adversary's) strategic decision making through actions that are perceived by the adversary to impose costs, deny benefits, and induce restraint. As outlined in this DoD concept, strategic no longer means nuclear, and potential deterrent actions span the elements of national power. The concept further attempts to balance the appropriate use of both carrots and sticks (i.e., inducements as well as threats) by understanding the adversary's point of view.

During the Cold War, deterrence became the military centerpiece of a successful grand strategy (containment) aimed at countering Soviet expansion. However, the opening years of the 21st Century present many different challenges for our military deterrence efforts. Deterrence must now be assessed in concert with the defense policy goals of assuring allies and friends, dissuading future military competition, and decisively defeating any adversary. These new challenges require a new concept for 'waging' deterrence paired with revised joint force capabilities that together provide the President a wider range of alternative military options for deterrence. Strategic deterrence requires a national deterrence strategy that integrates and brings to bear all national resources: diplomatic, informational, military, and economic. (Drawn from the SD JOC, February 2004.)

The requirement to apply the deterrence concept to non-state actors adds additional challenges: "Deterrence based only upon the threat of retaliation is less likely to work against leaders of rogue states more willing to take risks, gambling with the lives of their people, and the wealth of their nations . . . Traditional concepts of deterrence will not work against a terrorist whose avowed tactics are wanton destruction and the targeting of innocents; whose so called soldiers seek martyrdom in death and whose most potent protection is statelessness." -- National Security Strategy, September 2002.

## WG 4 – Focus Questions



- ◆ **How can analysts *characterize and measure uncertainty* concerning deterrence?**
- ◆ **How can deterrence analysts *determine and manage second- and third-order effects* in deterrence analysis?**
- ◆ **How can analysts *estimate the magnitude of an adversary's response* to a proposed deterrent action? Methods exist to determine the general response (e.g., favorable, unfavorable). This question concerns "How favorable?" or "How unfavorable?"**

We posed three questions to help frame discussions within the working group. These questions address three persistent issues concerning deterrence analysis to support the concept on the previous slide.

1. *How can analysts characterize and measure uncertainty concerning deterrence?*

Uncertainty comes in a variety of forms, including: the uncertain nature of the problem, intelligence available to inform the analysis, understanding of the adversary's decision making process, our ability to develop and communicate deterrent actions, the manner in which deterrent actions are received, unplanned actions that have unintended consequences, and the dynamic nature of strategic events. For example, how do we account for learning by unidentified (i.e., potential) adversaries?

2. *How can deterrence analysts determine and manage second- and third-order effects in deterrence analysis?* While we have methods to identify, and to some extent measure, the main effects (or intended effects) of our deterrent actions on adversary decision making, we have difficulties in identifying and accounting for cascading effects that come in a variety of forms. Some spillover effects are geographical (e.g., neighboring, regional, global); some are temporal (e.g., short term deterrence may contribute to longer-term instability); while others cross disciplines (e.g., economic actions having a diplomatic effect).

3. *How can analysts estimate the magnitude of an adversary's response to a proposed friendly deterrent action?* In most cases, we have methods to determine the general nature of an adversary's response to a specific deterrent action (e.g., favorable, unfavorable). What we lack are methods to determine "how favorable?" or "how unfavorable?" that response will be. Ultimately learning that reaction will help us develop coherent packages of deterrent actions.

"When viewing or analyzing other points of view, the meaning of any communication is the response elicited regardless of the intent of the speaker." -- A. Brown

## WG 4 – Working Group Structure



- Stage Setting
  - DoD Strategic Deterrence Concept
  - Deterrence Assessment Framework
- Problem/Discussion
  - Effects in the Cognitive Domain
    - Discussion: *Measuring Uncertainty*
  - Understanding Chinese Thinking
  - Gauging Adversary Response
    - Discussion: *Adversary Response*
  - Planning and Integrating Deterrence
    - Discussion: *2nd and 3rd Order Effects*
- Synthesis
  - Problem Description
  - Historical Vignette:
    - Deterrence Analysis Successes in OR
  - Methods and Tool Availability
  - Recommendations

This chart depicts the structure we used to achieve the workshop goals of identifying gaps in our analytic toolset as well as take up the three focus questions on the previous chart. Each presentation served the purpose of priming the group for discussions on our ability to analyze deterrence issues. While certain overlaps exist among the different presentations and discussions, the substantive effect of the whole was more than adequate to identify gaps in our ability to analyze deterrence.

Following these discussions, the group asked itself “Have we defined the problem (and problem space) correctly?” That is, we wanted to make sure that any effort to identify potential solutions (i.e., analytic methods and tools) should be applied against the right problem.

In the final break-out session, the working group identified methods and tools that have potential to address certain portions of the problem, and further developed the set of recommendations contained in this brief.

## WG 4 – Defining Deterrence



- **Scope of deterrence today**

- ◆ Ends: Beyond the most dire (i.e., nuclear) threats
- ◆ Ways: Beyond coercion to include inducements
- ◆ Means: Beyond military to include non-military (inter-agency)

- **Specifying the problem(s)**

- ◆ Coercion
  - Basic, extended, intra-war, persuasion
- ◆ Inducement
  - Engagement (alliances, coalitions), cooperation (international organizations), and assurance

- **Language and definition**

- ◆ Deterrence includes inducement
- ◆ MOEs and analysis for each of these may be different
- ◆ Perception by others may be different (assume deterrence is coercion)

Definitions are important: 1) The scope of deterrence, as described in the SD JOC, has expanded; 2) The recent DoD specification of different types of deterrence (e.g., tailorble, regional, global), may demand different types of analysis, methodologies, and tools, and, 3) Lack of a common language (terms and definitions) may have an impact on both analysis and execution.

Scope: The scope of deterrence is broader now than in the past. *Ends*: In the past, the focus was on most dire threats to national survival...usually nuclear. Today, we face a wider range of adversaries (e.g., non-state actors, state sponsors of terrorism) and a wider range of threats (e.g., cyber attacks, terrorism). *Ways*: In the past, deterrence was traditionally defined as using threats of denial or retaliation to prevent an adversary's hostile actions. Today, we include the use of incentives to improve the perceived consequences of inaction - a newer feature in the academic debate. *Means*: Broader means include non-military as well as military options.

Specification: In order to develop methodologies and/or analytic tools to study and assess deterrence, a number of aspects needed to be specified further. Much as Patrick Morgan had defined both general deterrence and immediate deterrence, the participants thought there were at least three levels of deterrence to include intra-war deterrence. Also, academic definitions of deterrence include: basic deterrence - deterring an adversary against attacking the US; extended deterrence - deterring attacks against allies; intra-war deterrence - deterring escalation during a conflict; and, persuasion - to get an adversary to take an action – such as withdrawing from seized territory, rather than preventing an action, such as seizing the territory to begin with.

Language: The use of language and definitions for deterrence could have an impact on operational and analytic considerations. If deterrence is commonly thought to involve the use of military threats, deterrence planning by the US may be misperceived by allies and adversaries alike as being purely or primarily coercive in nature, potentially resulting in misperceptions of US policies and unintended consequences. The term influence seems to better describe the broader range of actions involved in deterrence, however the term strategic influence (instead of strategic deterrence) might be problematic.

## WG 4 – Stakeholders and Roles in Policy and Plans



- **USG: NSC, Inter-Agency, IC, Congress**
  - ◆ National objectives: National Security Strategy+
  - ◆ Develop policy
  - ◆ Prioritization and allocation of resources
- **DoD**
  - ◆ Military objectives: National military strategy
  - ◆ Develop policy
  - ◆ Issue guidance: TSC guidance, CPG, SPG
  - ◆ Prioritization and allocation of resources
- **STRATCOM**
  - ◆ Develop global deterrence plan
  - ◆ Synchronize deterrence planning in other plans
- **Other COCOMs**
  - ◆ Regional commands, including NORTHCOM: Develop regional deterrence plans
  - ◆ SOCOM: Develop transnational deterrence plans

Because the broader concept of deterrence is still being developed in the USG, it is helpful to note stakeholder roles in developing deterrence policy and plans. These roles have implications for requirements and for the execution of deterrence policy. Therefore, this chart represents something of a two-way street with guidance for planning and execution flowing from the top down and requirements for guidance, resources, and collaboration flowing from the bottom up.

Two noteworthy points:

1. STRATCOM will likely play a lynch-pin role between the policy and guidance provided by DoD and the specific plans and actions developed by regional COCOMs. STRATCOM is tasked both with developing a Global Deterrence Plan and with synchronizing specific deterrence planning in other military plans.
2. Regional COCOMs will likely require support from STRATCOM to execute their specific deterrence plans. Likewise, STRATCOM may require support from the DoD, just as the DoD will likely require support from the broader USG (inter-agency) to conduct deterrence operations.

## WG 4 – Insights for the Deterrence Concept



This workshop informed the ongoing revision of the Strategic Deterrence Joint Operating Concept (SD JOC):

- ◆ Definition of deterrence
- ◆ Scope of the concept
- ◆ Cyber-deterrence
- ◆ Deterring non-state actors
- ◆ Communication of deterrence actions
- ◆ Planning and implementing deterrent actions
- ◆ Costs of deterrence actions to the US

The timing of the workshop was opportune for the further development of the deterrence concept. USSTRATCOM is the DoD's agent for maintaining and revising the SD JOC. In February 2006, that concept is mid-way through its first revision. Additionally, the working group had the officer from USSTRATCOM responsible for that revision as a participant.

This list highlights some of the more significant insights taken from the workshop that will feed directly into the revision of the SD JOC (likely to be re-named to the Global Deterrence Joint Operating Concept). Further details on these insights are given in the back-up slides.

## WG 4 – Attacking the Deterrence Problem



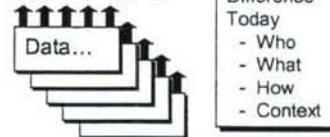
### Dimensions/factors

- Players (including capabilities and limitations)
- Decisions/actions
- Competition/cooperation
- Deterministic (stochastic/holistic)
- Goals/objectives (single vs. multiple, Political, economic, military?)
- Payoffs (+/-, costs/benefits) reduce problems of achieve, reduce benefits/increase costs, preference ordering
- Stages/phases
- Strategies (risk averse, mini-max, maxi-min)
- Interactions/Influences (2nd, 3rd order effects)
- Others.....

Match with ...

### OR Methodologies (Suite)

- Dynamic programming (stochastic or deterministic)
- Game Theory – (> 2 person), (non 0-sum), (multi-stage)
- Experimental gaming
- Impact/Influence diagrams
- Cost-benefits analyses
- Risk analysis (p[event] \* consequence)
- Decision trees/Decision analysis (value, utility)
- Cognitive mapping



Difference Today  
 - Who  
 - What  
 - How  
 - Context

Application of Methodology depends on the dimensions AND the question being asked or the decision to be made!

Appropriate question: Do certain actions contribute (detract from) deterrence or stability?

Inappropriate question: What is the probability that action X will deter actor Y from doing Z?

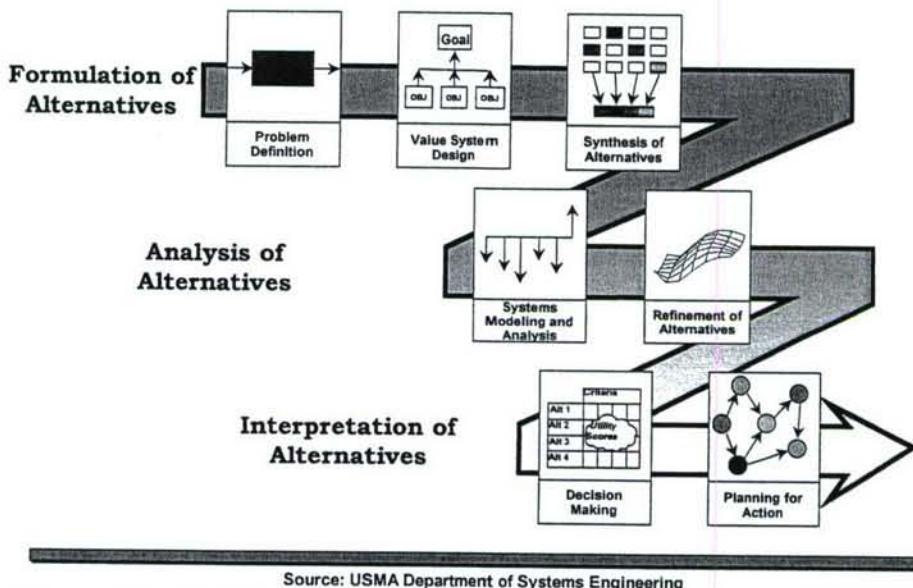
As an initial synthesis of the group's discussion, this slide depicts the multi-dimensional nature of the problem on the left, and some of the more promising operations research methods and tools available to help with deterrence analysis on the right. The group immediately and unanimously saw the need for a suite of tools for even the most basic deterrence analysis problems. This concurs not only with the other working groups, but also with the findings from other analytic venues, in particular the Defense Adaptive Red Team (DART) assessment of USSTRATCOM's deterrence analysis capabilities.

Underlying this suite of methods and tools is the need for data, and the nature of that needed data is changing, just as the concept has changed. (More is presented on the data issue later.)

The reminder at the bottom of the slide serves to bring us back to the sometimes-overlooked imperative to define the problem correctly. In this case, the focus of a substantial part of deterrence analysis is to develop sets of actions that will serve to further deter or to stabilize. What is often discussed, however, are the difficulties we have in quantifying the probability of an adversary's response. While interesting, that problem is usually not the effective focus of the analysis and serves to distract the analysts and decision makers.

In total, this slide represents an initial functional decomposition of the problem and helped the working group next identify gaps and potential solutions.

## WG 4 – Systems Engineering Design Process



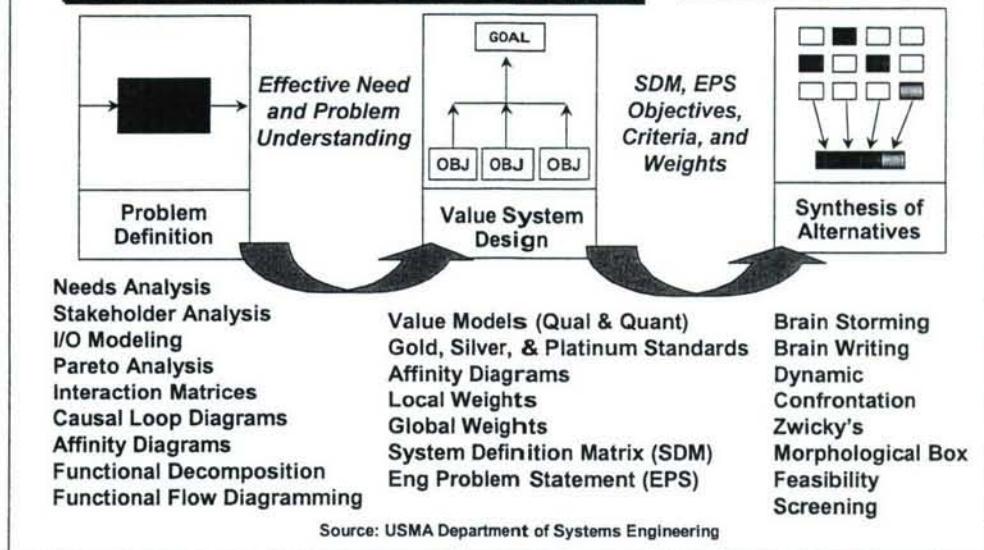
In developing the functional decomposition on the previous chart, the group quickly realized that we were identifying methods and tools for three broad types of analytic problems. The first is what we earlier referred to as defining the problem (and problem space) correctly. The second is analyzing the effects of certain deterrent actions on certain adversaries. The third is analyzing the impacts of individual and multiple actions on individual and multiple actors, the effects of all of these actions over time, and a variety of other types of second- and third-order effects.

These three problems roughly align with the three steps of many common systems engineering design processes. This chart shows one such process, from the Systems Engineering Department at the US Military Academy. It provides a framework of how to identify potential methods and tools, as each of these areas are well established and can be modified for the deterrence effort.

The *Formulation of Alternatives* step in the process is concerned with defining the problem, identifying stakeholders and their needs, criteria for decision making and developing sets of alternatives. The *Analysis of Alternatives* step involves gaining a sufficient understanding of each alternative and its relationship to the system in order to make a fully informed decision. The *Interpretation of Alternatives* step entails the framing of the problem in an understandable manner for the decision maker and developing implementation plans to achieve the system goals.

## WG 4 – Methods and Tools for Design

**Must both Scope and Bound the problem!**



As mentioned on the previous slide, one advantage of looking at an engineering system design process is that it allows us to draw upon a well-developed field of expertise. For example, this slide depicts general methods and tools to help system analysts accomplish each of the sub-steps in the *Formulation of Alternatives* portion of the process. Similar lists, as well as descriptions of each method or tool, are available for the remaining portions of the process.

The caution at the top of the chart reminds us that we need to first consider all possible aspects of the problem (scope), and then eliminate irrelevant or infeasible aspects of the problem (bound) so that we are left with a concise definition of the problem that, when solved, will address the effective need.

Insufficient understanding and scoping of the problem often leads to solutions that do not account for the significance in the relationships. In this case, insufficient scoping would likely cause critical 2nd and 3rd order effects of deterrent actions to be omitted or misused, and significant or important sources of uncertainty to be overlooked. On the other hand, a feeble bounding effort can often lead to problems that are intractable, either because of their complexity or because the data requirements are infeasible. In this case, not bounding the deterrence problem (e.g., trying to analyze general deterrence that accounts for all global effects and interactions) would only bog down the objective, and most likely expend the analytic budget more rapidly.

## WG 4 – Method and Tool Availability



Different scenarios require different tools: Scenario A: strategic nation-state WMD problem Scenario B: Non-state actor WMD problem		Problem Definition	Direct Effects	2nd & 3rd Order Effects	Uncertainty	
Methods	Example Tools	Scoping and Bounding (SOT, objective) Stakeholder Analysis	Needs Analysis Identifying 2nd and 3rd order effects	Adversary Decision-Making Process (how does he decide?) Assessing Adversary Response (how an effect?)	Assessing Magnitude of Adversary Response (how much of an effect?) Geographic (meta, regional, global) Sensity Effects Temporal (future option)	Character Reduce & Manage
Mathematical Programming	Dynamic (stochastic or deterministic)			X		X
Network Analysis	Network analysis, belief networks				X ?	X
Risk Analysis	risk maps					X X
Cost-benefits Analysis	cost-benefit ratio			X		
Influence Analysis	causal diagrams, agent-based models	X X X X	X	X	X	X X
Decision Analysis	decision trees, prospect approaches			X X		X X
Game Theory	> 2 person, non 0-sum, multi-stage			X		
Experimental Gaming	SME, Deterrence gaming, roleplaying		X	X X X X X X		
Organizational Effectiveness	goals tree, cognitive mapping	X				
	functional decomposition	X	X X			
	VO modeling	X	X X			
	basic research	X	X	X		
	brainstorming	X	X			

Combining the functional decomposition presented earlier with the understanding of the system engineering design process gives us a framework to assess method and tool availability for deterrence analysis. This is certainly not a definitive mapping of tools to problems! In fact, even if we could account for all significant methods and tools, the mapping would be incomplete as the potential changes based on the nature of the problem. This means that what is learned in the problem definition step in part determines which tools are appropriate for analysis later in the process.

Instead, this chart serves to indicate a general potential, using the professional estimate of the workshop participants. In some cases, these methods and tools have already been applied to the indicated analytic tasks; in other cases, they have not. More importantly, the group identified a number of tools that *theoretically* could be applied to certain tasks, but whose data collection would likely drain the national budget, or are otherwise completely infeasible. For example, mathematical network models used to examine complex systems might help one to understand the decision making processes in terrorist networks, but that understanding would likely require describing each node and edge in the network to some sufficient level.

In his plenary brief, Dr. Hanley reminded the workshop that analytic tools must be usable (interpretable), extendable and replicable. To these criteria, OSD's COL Patrick Kelly added the reminder that the analysis must be completed in time to be relevant to the decision maker.

## WG 4 – Method and Tool Availability



Different scenarios require different tools: Scenario A: strategic nation-state WMD problem. Scenario B: Non-state actor WMD problem		Problem Definition	Direct Effects	2nd & 3rd Order Effects	Uncertainty	
Methods		and Boundary (SOI): - Inter Analysis - Subject - 2nd and 3rd order	Decision Making (How does he decide?) - Adversary Response (What is he doing?)	Magnitude of - Response (How much) - Impact, response Effects	Impact options - Future options	Reduce & Manage
Mathematical Programming						x
Network Analysis						x
Risk Analysis						x x
Cost-benefits Analysis						x
Influence Analysis						x x
Decision Analysis						x
Game Theory						x
Experimental Gaming						
<b>◆ Significant Gaps in determining the impacts of second and third order effects, and measuring the magnitude of adversary responses.</b>						
<b>◆ Data availability eliminates some models.</b>						
<b>◆ Timely methods required to inform decisions.</b>						
<b>◆ Human-in-the-loop methods often best choice.</b>						
Organizational Effectiveness		goals tree, cognitive mapping	x			
functional decomposition		x	x x			
VO modeling		x	x x			
basic research			x x x			
brainstorming		x	x			

While the method and tool mapping highlights general potential, it does not capture specific strengths and weaknesses, which specific tools are best suited for specific problems, or what priorities among tools and gaps. However, based on the expertise of the group, we were able to draw some general conclusions:

- As expected, there are no silver bullets waiting to be discovered that will address all, or even most, of the aspects of the deterrence analysis problems.
- We face significant gaps in two of the three focus areas laid out at the beginning: determining the impacts of second and third order effects, and determining the magnitude of an adversary's response. The focus area of characterizing, reducing and managing uncertainty is substantially covered with the well developed risk analysis methods.
- As mentioned previously, the data requirements for some approaches likely rule out those approaches.
- Because of the data non-availability problem, the human-in-the-loop (HITL) approaches (e.g., role playing, wargaming) are often the best choice. This is completely reasonable given the current state of the art for deterrence analysis. HITL methods are often excellent, and inexpensive, choices for addressing formative problems.

## WG 4 – Additional Points to Consider 1



- **Problem Definition**
  - ◆ The problem is well-scoped; work is needed to bound the problem (all deterrence, or just strategic deterrence? All forms of influence?)
  - ◆ Throughout the workshop, we used at least seven deterrence terms
    1. Strategic deterrence
    2. Tailored deterrence
    3. Global deterrence
    4. Transnational deterrence
    5. Regional deterrence
    6. Immediate deterrence
    7. General deterrence
  - ◆ How do we account for the dynamic nature of the problem?
- **Metrics**
  - ◆ Are we asking the right questions to guide metrics development? (Instead of trying to respond to the question, "What are the metrics?")
  - ◆ What are those questions?
  - ◆ What decisions will be informed by the metrics?

Here, well-scoped indicates that a sufficient number of important relationships concerning strategic decision making have been identified. This does not mean that these relationships have been described in detail or adequately modeled. Streamlining the problem (essentially, determining the context of interest) is more difficult to do, particularly in the abstract. However, at the top level, some streamlining would enhance deterrence analysis simply by providing focus. For example, of the seven deterrence terms on the chart, only the first has a clear definition adopted by the DoD.

The dynamic nature of the deterrence analysis problem becomes more important as the DoD continues to move toward a continuous and global approach to deterrence. Essentially, this means that future deterrence plans will not be static plans but will be plans that will be continuously reviewed for execution, with feedback, revisions, and constant consideration of new possible courses of action.

These problems are dynamic in that they change, even as they are being solved. Not only do the elements of the problem change over time, but fundamental relationships change over time.

Useful metrics generally flow from a well-defined problem. If analysts start by defining metrics (before defining the problem), the resulting set of measures is often inappropriate or unusable.

## WG 4 – Additional Points to Consider 2



### • Methods

- ◆ Allow for competitive analysis to provide better integration of knowledge and methods; not all redundancy is bad
- ◆ There is value in outsourcing analysis; can help avoid single points of failure
- ◆ Consider the impact of expert opinion as a source
- ◆ Analyses requires inter-disciplinary collaboration
- ◆ Develop methods to validate analysis
- ◆ Develop methods to address the role of ambiguity in deterrence
- ◆ Methods must be usable/understandable, extendable, and replicable

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In our quest to use our resources efficiently, we often try to remove all redundancies. However, in many cases having different groups work on the same problem is very helpful in providing insight into the nature of the problem, especially regarding the uncertainties involved.

In general, methods exist for many aspects of deterrence analysis, but new or refined methods are required for some of the more difficult parts. Because the object of the analysis (the adversary's decision making calculus) is very difficult to observe, measure, and analyze, it is not surprising that methods that deal with the uncertain nature of the problem are at the top of the list of needed tools.

## WG 4 – Recommendations



- **To DoD/Sponsors**
  - ◆ Carefully define scope and roles concerning deterrence
  - ◆ Drive development of deterrence policy, analysis and planning across USG and DoD
  - ◆ Sponsor focused research in difficult areas, e.g. integration of analysis, characterization of uncertainty
- **To MORS**
  - ◆ Provide a mentor to each WG (*a la* Rist mentors)
  - ◆ Engage MORS to accommodate/encourage greater IA participation
  - ◆ Hold MORS Workshop on Influence Operations
  - ◆ Sponsor MORS competition for difficult problems

We look to the DoD to provide the needed definitions, guidance, and policy concerning deterrence. These elements would serve to not only define roles and responsibilities, but they would also drive deterrence analysis and planning across the DoD (and USG). By sponsoring research along the lines of the difficult analytic tasks in this brief, the DoD would help energize and synchronize the greater community of interest.

MORS is uniquely positioned to play a critical role in continuing the development of OR tools and methods, and more importantly, the development of analysts to tackle these tough problems. In particular, broadening the traditional scope of MORS beyond the DoD will help to move the analytic community closer to the problem, help define boundaries, and better prepare analysts for the tough work ahead.

## WG 4 – Backup Material 1



*Workshop Insights to inform the Strategic Deterrence  
Joint Operations Concept*

## WG 4 – Deterrence Concept Insights 1



### Definition and Scope

- **Definition – reconsider classic definition**
  - ◆ Classic deterrence primarily considers cost/benefit of action
  - ◆ Also consider - Cost/benefit of inaction (SD JOC – *induce restraint*)
    - ➔ Not a classic definition of deterrence, but practical
    - ➔ Includes inducement for inaction or alternative
    - ➔ Deterrence is necessary, but not sufficient for stability
    - ➔ Desire cost/benefit of inaction is greater than the cost/benefit of action
    - ➔ Achieve stability within deterrence
- **Current scope of JOC is *Strategic* Deterrence**
  - ◆ Expand discussion that concept may be applied at a strategic, operational, or tactical level to achieve a strategic effect

## WG 4 – Deterrence Concept Insights 2



### Application

- Strategic concept can also be applied by operational and tactical level commanders to deter attack
  - ◆ Requires some level of adversary analysis
- Discuss cyber-deterrence as another deterrence objective
- Manage expectations of deterrence
  - ◆ Can't deter all attacks → credibility will suffer
  - ◆ If the attack is not catastrophic, then we mitigate effects and drive on
  - ◆ Attacks will happen in a long war
  - ◆ Broad policy statements are potentially difficult in application
- Expand the discussion of immediate versus general deterrence
  - ◆ Consider effects of immediate deterrence actions on general deterrence
- Examine the efficacy of clarity of intent (including demonstrated capability) versus declaratory policy

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## WG 4 – Deterrence Concept Insights 3



### Communicating Deterrent Actions

- **Focus on the how of communication as well as the what**
  - ◆ The meaning of any communication is the response elicited, regardless of the intent
- **Communication with adversary – learn how to effectively communicate**
  - ◆ Delivery Methods – What sources does adversary pay attention to? What sources does adversary trust?
  - ◆ Format of the message – to impact or to influence?
  - ◆ How do we effectively communicate with adversary?
- **Examine how messages will be delivered and manipulated**
- **Is there a model that can help demonstrate how communication of a message occurs**
  - ◆ Primary effect on adversary
  - ◆ Secondary effect on other parties, domestic audience
  - ◆ Is there a bio-model that applies?
  - ◆ Can we inoculate certain societies against misinformation?

## WG 4 – Deterrence Concept Insights 4



### Non-State Actors

- Examine the efficacy of deterring terrorists
  - ◆ May not be able to expend the necessary resources and time to effectively deter
  - ◆ US may be morally restrained from imposing costs (or providing benefits)
  - ◆ Benefit denial may be of increasing importance with terrorists
- Difficult to identify (and thus understand) the actor to deter
- Often not interested in stability – cost of inaction may be too high
- Want to upset the status quo – for purpose of changing the system
- Can we deter those committed to dying for a cause? Yes, decision calculus still applies
- Costs of deterring extremists may be too high
- In many cases deterrence has already failed; further deterrence efforts are escalation control
- Denying benefits often most effective way to deter terrorists
- Need to determine how to influence/deter a networked actor (model network)

## WG 4 – Deterrence Concept Insights 5



### Planning and Implementation

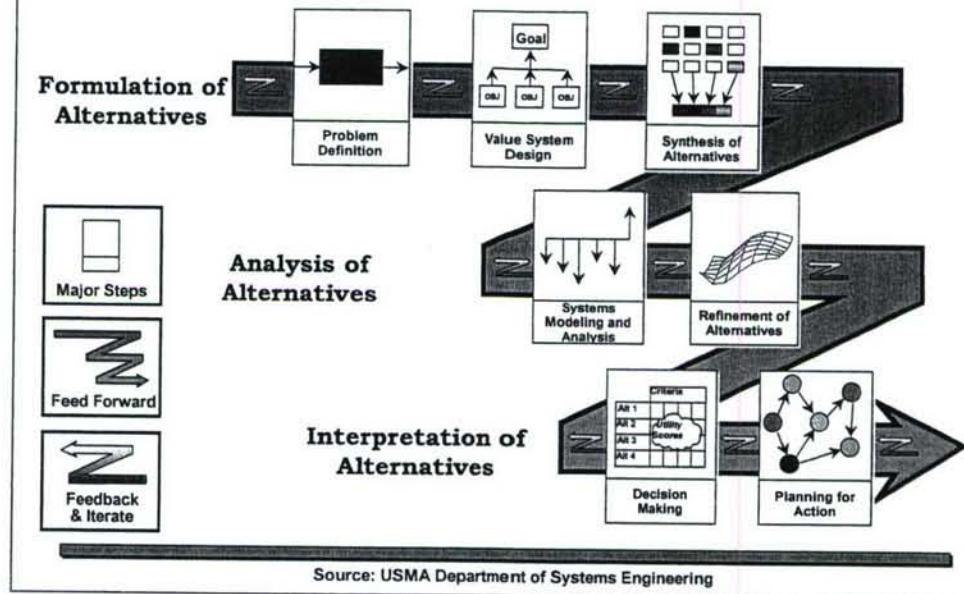
- **Require the ability to characterize uncertainty in decision models**
  - ◆ Uncertainty rises from a lack of understanding of adversary decision making
  - ◆ Ability to model uncertainty would be very helpful to decision makers
  - ◆ Determine how to design strategy and plans around a range of uncertainty
  - ◆ Eliminate unlikely cases, incorporate cases with dramatic impact
- **Require the ability to model non-DoD means that affect deterrence**
- **Require models to show deterrent effects caused by proposed changes in force posture/basing**
- **Require models that demonstrate deterrent impact of nuclear weapons on deterrence (more than a mathematical model of damage)**
- **Need tools to help show 2nd and 3rd order effects of deterrent actions**
  - ◆ Effect on who you are targeting?
  - ◆ Effect on other adversaries, allies, friends, neutrals (3rd party)
- **Need models to gain insight into various methods to deter non-state actors**

## WG 4 – Backup Material 2



*Systems Engineering Design to Help Frame the  
Deterrence Analysis Problem*

## WG 4 – Systems Engineering Design Process

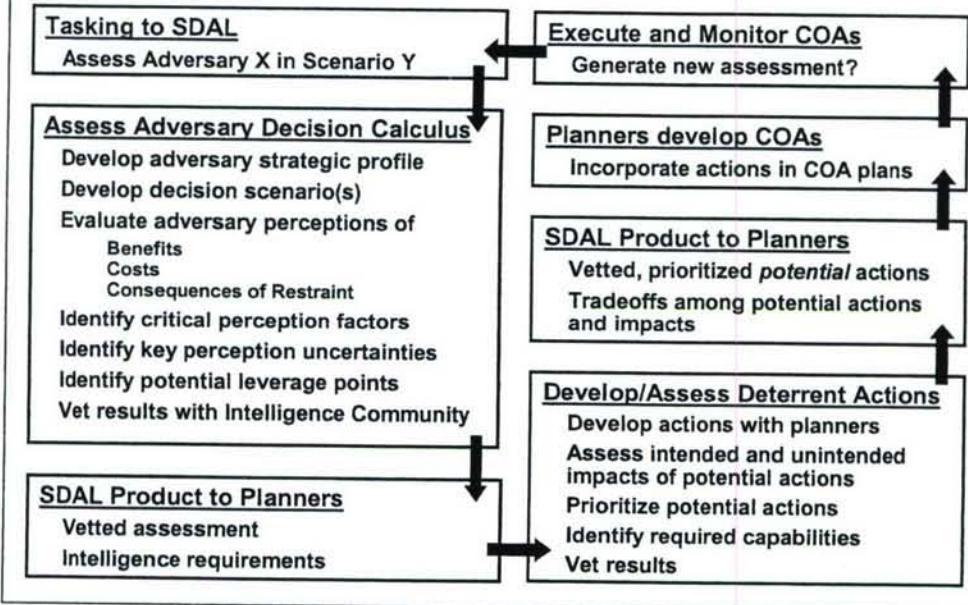


## WG 4 – Systems Processes Mapping 1



<i>Systems Engineering Design Process (SEDP)</i>	<i>Systems Engineering and Management Process (SEMP)</i>	<i>Application: Military Decision Making Process (MDMP)</i>
<b>1. Formulation of alternatives</b> <ul style="list-style-type: none"> <li>a. Needs analysis</li> <li>b. Value systems design</li> <li>c. Synthesis of alternatives</li> </ul>	<b>1. Problem definition phase</b> <ul style="list-style-type: none"> <li>a. Needs analysis</li> <li>b. Value systems design</li> </ul> <b>2. Design and analysis phase</b> <ul style="list-style-type: none"> <li>a. Alternatives generation</li> </ul>	<b>1. Receipt of mission</b> <b>2. Mission analysis</b> <b>3. COA development</b>
<b>2. Analysis of alternatives</b> <ul style="list-style-type: none"> <li>a. Modeling and analysis</li> <li>b. Refinement of alternatives</li> </ul>	<ul style="list-style-type: none"> <li>b. Modeling and analysis</li> </ul>	<b>4. COA analysis</b>
<b>3. Interpretation of alternatives</b> <ul style="list-style-type: none"> <li>a. Decision making</li> <li>b. Planning for action</li> </ul>	<b>3. Decision making phase</b> <ul style="list-style-type: none"> <li>a. Alternatives scoring</li> <li>b. Decision</li> </ul> <b>4. Implementation phase</b> <ul style="list-style-type: none"> <li>a. Planning for action</li> <li>b. Execution</li> <li>c. Assessment and control</li> </ul>	<b>5. COA comparison</b> <b>6. COA approval</b> <b>7. Orders production</b> <b>8. Rehearsal</b> <b>9. Execution and assessment</b>

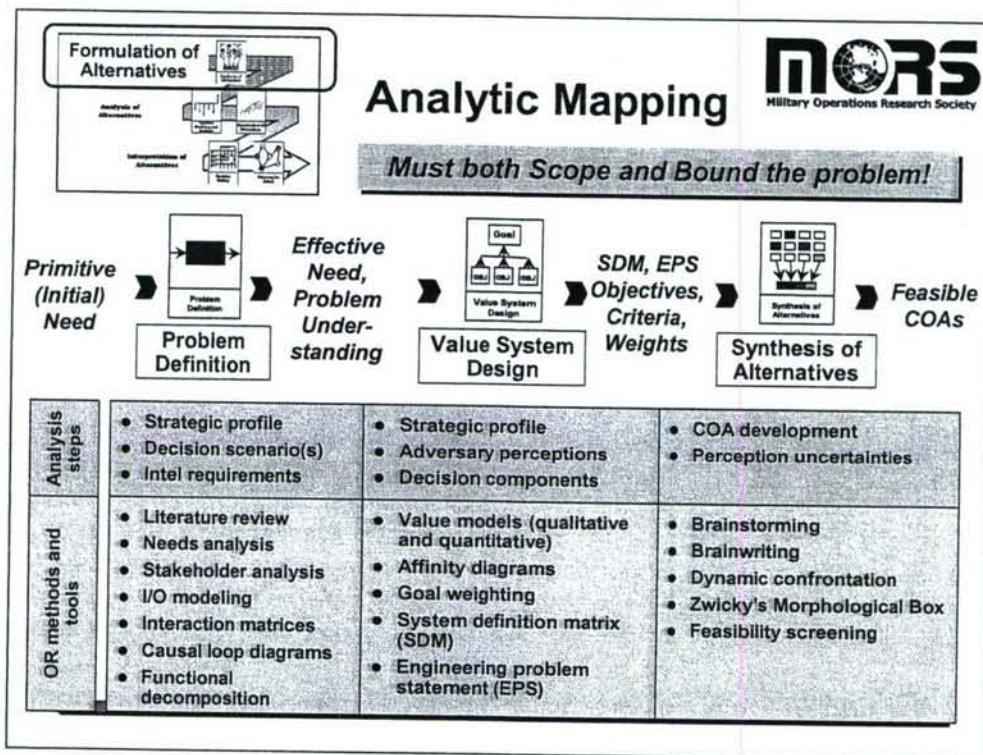
## WG 4 – Deterrence Assessment Process

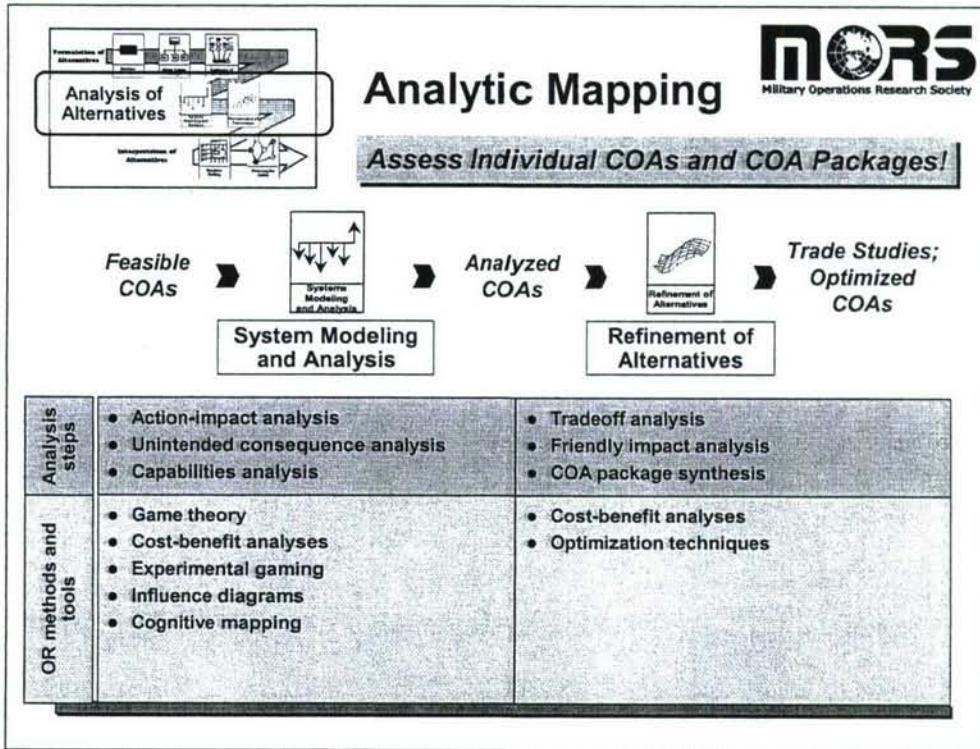


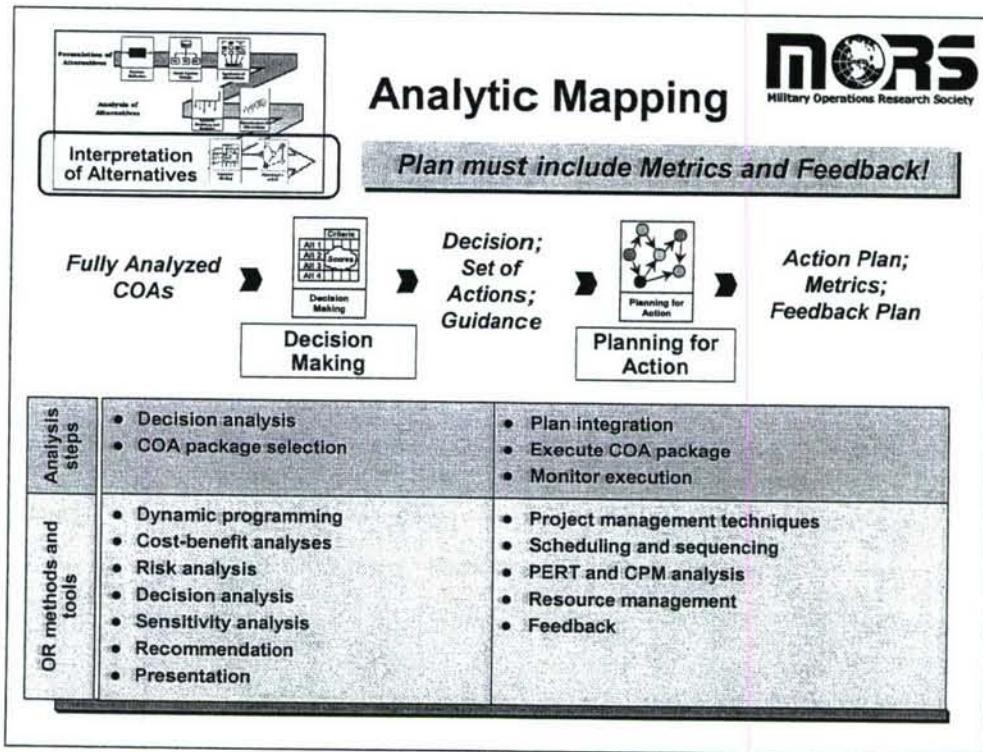
## WG 4 – Systems Processes Mapping 2



<i>Systems Engineering Design Process (SEDP)</i>	<i>Application: Strategic Deterrence Analysis</i>
<b>1. Formulation of alternatives</b> a. Needs analysis b. Value systems design c. Synthesis of alternatives	<b>1. Define deterrence objective</b> <b>2. Assess adversary decision calculus</b> a. Strategic profiling b. Decision evaluation (C/B/CR) c. Decision component analysis (perception factors, uncertainties, leverage points, intelligence requirement's) <b>3. Develop deterrent options</b>
<b>2. Analysis of alternatives</b> a. Systems modeling and analysis b. Refinement of alternatives	<b>4. Assess deterrent options</b> a. Action-impact analysis b. Unintended consequence analysis c. Capabilities analysis <b>5. Develop COA packages</b> a. Tradeoff analysis
<b>3. Interpretation of alternatives</b> a. Decision making b. Planning for action	<b>6. Select COA package</b> <b>7. Execute and monitor</b>











# **Analysis for Non-Traditional Security Challenges: Methods & Tools**

**Military Operations Research Society  
(MORS) Workshop**

**WG 5 - Decision Making And Integration  
Outbrief**

**Dr. Greg Parnell, USMA**

**Steve Richter, JHU/APL**

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This document provides an annotated briefing of the report of Working Group 5, Decision Making and Integration.

## WG 5 – Charter



- **Initial**

- ◆ "Effective decision making requires new methods and tools to incorporate non-traditional challenges. Existing methods of collaboration will need to be reevaluated to consider the effects of incorporating the new challenges across all levels of classification."

- **Final**

- ◆ "Using the QDR as a starting point, assess the decision making and integration issues of future non-traditional security challenges. Focus on force sizing issues for FY08 POM."

### WG-5 Contribution

We assessed our ability to measure the capabilities identified in the four QDR Focus Areas. We concluded that we need better measures for many of the capabilities that will have the most impact on non-traditional security challenges. We also found that risk analysis may be the most promising resource allocation framework for two of the four areas.

The co-chairmen of the working group struggled with the definition of "decision making and integration" as applied to this workshop. Numerous discussions with workshop sponsors resulted in a refined charter, one more focused on assessing the implications of QDR 2005. The group was tasked with examining the capabilities the QDR identified as critical for meeting the strategic, operational and tactical objectives of four focus areas:

1. Defeating terror networks;
2. Defending the homeland in depth;
3. Shaping choices of countries at strategic crossroads; and,
4. Preventing the acquisition or use of WMD -

and then assessing the implications of those capabilities with respect to impact on force size and shape.

Working Group 5 found that deficiencies lie in our ability to measure how well these capabilities answer non-traditional security challenges, and that these shortfalls will need to be mitigated in order to better understand resource allocation requirements — not only within the DoD, but across all government agencies tasked with supporting response to non-traditional security challenges we will face during the long war.

Finally, Working Group 5 presented some analysis that indicates that the nature of these challenges may call for a broadening of our analytic tool-kit, to include wider use of social science and risk analysis methodologies, particularly in the areas of WMD and defense of the homeland.

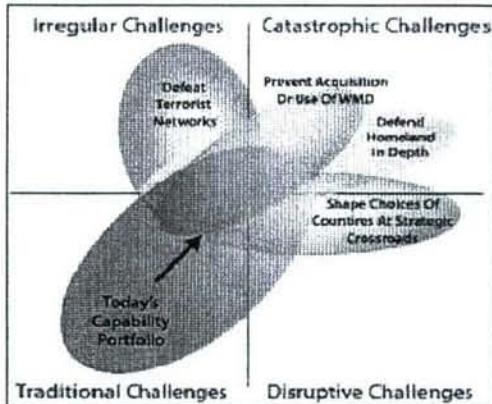
## WG 5 – Overview



- **WG 5 framework for analysis**
- **Characterize the future (2025)**
  - ◆ Environment
  - ◆ Threats
  - ◆ Opportunities
- **Focus on decision making**
  - ◆ Decision makers
  - ◆ Decision maker questions
  - ◆ Integration challenges
- **Assess QDR capabilities**
  - ◆ Identify capabilities that will influence force sizing
  - ◆ Identify or develop measures for force sizing capabilities
- **Assess resource allocation frameworks**
- **Recommendations**
- **Next steps**

This slide provides an outline of our WG brief.

## WG 5 – Decision Making and Integration



As the diagram shows, the Department is shifting its portfolio of capabilities to address irregular, catastrophic and disruptive challenges while sustaining capabilities to address traditional challenges.

QDR, page 19

- Framework for Analysis for each of 4 QDR focus areas
  - ◆ Characterize future (2025)
    - Range of operations that our forces may be required to support
  - ◆ Identify decision making and integration questions
  - ◆ Assess QDR capabilities
    - Identify capabilities that will influence force sizing
    - Identify or develop measures for force sizing capabilities
- How would this change the joint analytic agenda
  - ◆ Time phase

In order to provide context for follow-on analysis, Working Group 5 thought it necessary to discuss and describe the future environment, including potential changes to the threat, strategic drivers and advances in technology. Under this redefined future, considerations for future force employment were discussed, and then mapped to the set of required capabilities listed in the 2005 QDR report.

The group focused on decision making and integration challenges presented by the future environment in the context of future force planning under the QDR 2005 focus areas. The basic questions the group tried to answer were:

“Given the four focus areas within the non-traditional security challenges, which capabilities will influence force size?”

and

“How can we measure those capabilities?”

## WG 5 – QDR Focus Area Team Members



Defeat Terror Networks	Defend Homeland in Depth	Shaping Choices of Countries at Strategic Crossroads	Preventing the Acquisition or Use of WMD
CDR Bryan Clark	Chris Appleby	Jeff Brown	Venton Duncan
Amy Henninger*	Sue Iwanski, FS*	Jason Dechant*	Bill Greer
Steve Hunt	Alice Ling	Kim DeWitt	Erik Jilson
LTC Zvi Mintzer	Bryan Linkous	Craig Munshower	Steve Richter
John Regner	Rafael Matos	Janet Peasant	Phil Sauer*
Wayne Zandbergen	CAPT John Yurchak	Marla Roth	
		Tom Sterle	

\* Lead

Each focus area team produced annotated briefing of their analysis.

Working Group 5 was divided into four sub-groups — one for each of the four QDR focus areas. Each group (team) was provided the same task, and asked to proceed independently. The objective was to look at each focus area and integrate the results, identifying common elements of the assessments of future threats, the strategic environment and opportunities.

The teams were asked to identify key decision makers — and postulate the type of questions they might ask in each of the four focus areas.

Each team produced an annotated briefing of their analysis.

## WG 5 – Future: Environment



- **Defeat terrorist network**
  - ◆ The internet will be pervasive and exploitable for good and evil
  - ◆ Data will be plentiful but noisy and hard to analyze for desirability
- **Defend homeland in depth**
  - ◆ Status quo or significant shift in magnitude of defense budget and/or authorities
  - ◆ Integrated or balkanized interagency operations
  - ◆ High trust partnerships or low trust, independent relationships
- **Shaping choices of countries at strategic crossroads**
  - ◆ Complexity created by influencing factors (e.g., foreign governments, NGOs, industry)
  - ◆ Capability deltas between allies, partners, and adversaries
- **Preventing the acquisition or use of WMD**
  - ◆ Adversaries - state, non-state, individuals with increased access to knowledge/resources
  - ◆ Cyber and near space concerns

Future catastrophic events will shape the environment.

In describing the future, the groups concluded that the proliferation of data and information, coupled with the ability to rapidly share that information, creates a level playing field for the US, her partners and adversaries. While data is expected to be plentiful, the challenge will continue to be in sifting the information to find elements that contribute to problem description, analysis and solution.

Uncertainties in the expected degree of government agency cooperation, future levels of funding and the evolution of partnerships (both within the structure of government and internationally) present challenges for effective defense of the homeland.

The future environment will be complex and driven by numerous factors. Shaping objectives will be complicated by interests that extend beyond traditional government relationships, and will be influenced by differing levels of technological capability, operational capabilities and system interoperability amongst cooperating military forces, law enforcement and other agencies.

Future catastrophic events will shape US policy, decisions and courses of action.

## WG 5 – Future: Threats in Long War



- Terrorist organizations and individuals
  - ◆ State sponsored
  - ◆ Ideological (not state sponsored)
  - ◆ Religious fundamentalists
  - ◆ Anti-globalization groups
  - ◆ Criminally-based networks
- Strategic drivers
  - ◆ Geo-politics will shift QDR 2005 key regions
  - ◆ Globalization and proliferation of technology
  - ◆ Impact of demographic trends
  - ◆ Competition for strategic resources (energy, water, etc.)
- Threat technology advances
  - ◆ CBRNE/future technology (nano, biological); novel technologies outside WMD paradigm
  - ◆ Indiscriminate adversary delivery
  - ◆ New combinations
  - ◆ Perception control and management

### Asymmetric challenge – cost imposing strategies

Many expect terrorism to be the dominant threat in the long war. However, beyond terrorism fueled by religious or ideological extremism, anti-globalization groups may become more active (and perhaps, more violent) in attempts to disrupt the global economy by harassing the flow of energy and transportation of goods and services.

A challenge for the US and her partners will be in predicting future geographic hotspots. The 2005 QDR has indicated a shift in US strategic thinking from the long-standing three-hub construct to one that takes a more nation-specific approach. It is possible that other challenges (regional and trans-national instead of national) will become evident, perhaps rendering current plans and programs less than optimal. Inversely related demographic trends in the developed and developing worlds may be an important indicator as we attempt to remain appropriately focused upon future security challenges. Religious extremism may be replaced by competition for scarce resources as the key strategic driver of world events.

The long war is expected to be asymmetric. America may be faced with countering cost-imposing strategies executed by non-state actors.

## WG 5 – Future: Opportunities



- **For all four focus areas there are significant opportunities for cooperation at multiple levels**
  - ◆ Interdisciplinary
  - ◆ Intraservice
  - ◆ Intradepartmental
  - ◆ Interagency
  - ◆ Regional
  - ◆ International

---

All four subgroups identified opportunities for (and perhaps, the necessity of) increased cooperation, collaboration and integration across organizational boundaries. The groups felt that the nature of the non-traditional security challenge will require cooperation and integration — not only organizationally, but from force planning, resource allocation and operational perspectives as well.

We believe that the first step for military operations research analysts is increased multidisciplinary participation in our studies and analyses. We will need to include psychologists, sociologists, economists, international relations experts, and many other disciplines.

## WG 5 – We Need to Identify the Decision Makers



Decision makers and stakeholders span Defense Senior Leader Council, Senior Leader Review Group, OSD, Services, government departments, agencies, Congress, allies and partners.

Execution authorities

- Defeat terrorist network
  - ◆ SOCOM
  - ◆ Other COCOMs
- Defend homeland in depth
  - ◆ NORTHCOM, DHS
  - ◆ US State Governors and National Guard
- Shaping choices of countries at strategic crossroads
  - ◆ SECDEF, CJCS, COCOMs
  - ◆ Interagency
- Preventing the acquisition or use of WMD
  - ◆ STRATCOM, NORTHCOM, DHS
  - ◆ US State Governors and National Guard

This slide identifies some of the major decision makers and stakeholders involved in the non-traditional security challenges. In addition, each focus area has a complex set of execution authorities.

The decision making for traditional security challenges is complex. By contrast, the subgroup teams found that the structure required to ensure integrated, coordinated decisions in support of the non-traditional challenge to be exponentially more complicated. This increased complexity results from the need for intraservice, interservice, interdepartmental and interagency collaboration and cooperation.

## WG 5 – Expected Questions From Decision Makers



- **Defeat terrorist network**
  - ◆ What is the return on investment within capabilities?
  - ◆ What are the trade spaces between capabilities?
- **Defend homeland in depth**
  - ◆ What is the relative payoff of awareness and consequence management?
  - ◆ What balance of capabilities across layers of defense (home vs. away)?
- **Shaping choices of countries at strategic crossroads**
  - ◆ Which are the key countries we need to or can shape?
  - ◆ What does the DoD have/need to accomplish shaping and who are our partners?
  - ◆ How should we allocate resources across competing objectives?
- **Preventing the acquisition or use of WMD**
  - ◆ What are the investment priorities? How much is enough?
  - ◆ What are our adversaries' measures of success?

How does DoD balance capabilities and risks with limited resources?

In order to help those that are focused on developing and delivering tools designed to inform decision makers, the subgroup teams developed a list of generic questions that senior leaders might ask analysts to answer.

The non-traditional nature of current and future security challenges drives questions that extend beyond the “how many, how much” of current planning. Our future analytic tools must be able to answer questions and provide insight on issues as complex as return on investment, balancing resource allocation across organizational boundaries, the operational and strategic impact of capabilities and cost benefit.

Future analytic tools must facilitate discussion of risk — technological, operational and fiscal — in order to fully inform leadership regarding the impact of a particular decision.

## WG 5 – Each Focus Area Faces Challenging Integration Issues



- **Technical**
  - ◆ Capability measures
  - ◆ Data
  - ◆ Models and simulation
  - ◆ Systems of systems integration (optimization across services, platforms and CONOPS)
- **Resource**
  - ◆ Matching tools to objectives
  - ◆ Apportionment across AORs
  - ◆ DoD and other department
- **Organizational**
  - ◆ Reconciling innovation with integration
  - ◆ Resistance to change (cultural, organizational)
  - ◆ Leadership buy-in and commitment
- **Political**
  - ◆ Interagency, allied, coalition, NGO

As stated earlier, integration provides a clear path to better functional capability and performance against the challenges presented in a non-traditional environment. Working Group 5 identified several challenges that must be overcome in order to develop effective and efficient decision making.

Technical issues, driven by data and metrics, and resource questions must be answered to provide the foundation for sound research, development and procurement investment decisions. Cultural and organizational biases present challenges to integration, and leadership's support of the overall objective will be key to overcoming resistance to change.

Developing closer relationships and opening effective lines of communication will be an important step in attaining the integration required to improve decision making.

## WG 5 – Defeat Terrorist Network Capabilities



1. \*\* Human intelligence to discern the intentions of the enemy.
2. Persistent surveillance to find and precisely target enemy capabilities in denied areas.
3. Capabilities to locate, tag, and track terrorists in all domains including cyberspace.
4. Special Operations Forces to conduct direct action, foreign internal defense, counter terrorist operations and unconventional warfare.
5. Multipurpose forces to train, equip, and advise indigenous forces, deploy and engage with partner nations, conduct irregular warfare, and support security stability transition and reconstruction operations.
6. \*\* Capabilities and organizations to help fuse intelligence and operations to speed action based on time sensitive intelligence.
7. \*\* Language and cultural awareness to facilitate the expansion of partner capacity.
8. Non lethal capabilities.
9. Urban warfare capabilities.
10. Prompt global strike to attack fleeting enemy targets rapidly.
11. Riverine warfare capabilities to improve the ability of US forces to work with the security forces of partner countries to deny terrorist groups the use of waterways.
12. \*\* Ability to communicate US actions effectively to multiple audiences, while rapidly countering enemy agitation and propaganda.
13. \*\* Joint coordination, procedures, systems, and when necessary, command and control to plan and conduct complex interagency operations.
14. \*\* Broad flexible authorities to enable the United States to rapidly develop the capacity of nations to participate actively in disrupting and defeating terrorist networks.

Need capability measures.

QDR 2005 identified 14 key capabilities required to defeat a terrorist network. Of that list, our working group believed that six capabilities present challenges for analysts and model developers due to the absence of appropriate measures of effectiveness. (*Indicated with \*\* before the capability.*)

## WG 5 – Focus Area: Defeat Terrorist Network



### Assess the QDR capabilities - High Impact

	<u>Cost</u>	<u>Availability</u>
◆ ** Language and cultural awareness to facilitate the expansion of partner capacity	Low	Near
◆ ** Ability to communicate U.S. actions effectively to multiple audiences, while rapidly countering enemy agitation and propaganda	Low	Near
◆ ** Human intelligence to discern the intentions of the enemy	Low	Mid
◆ Prompt global strike to attack fleeting enemy targets rapidly	High	Near
◆ ** Capabilities to locate, tag, and track terrorists in all domains including cyberspace	High	Far

Need capability measures.

Of the six capabilities which we assessed as not having well developed metrics, four are assessed as having high impact on force planning. (*Indicated with \*\* before the capability.*) Analytical effort will be required to develop measures for these capabilities. Without clear capability measures, our efforts to improve these capabilities may not be effective or efficient.

## WG 5 – Focus Area: DHiD



- **Assess the QDR capabilities for DHiD [Cap=Capability]**

Cap1 Joint Cap2 for HLD and Civil Support  
Cap2 Air and Maritime Domain Awareness  
Cap3 Consequence Management  
Cap4 Medical Countermeasures  
Cap5 Tailored Deterrence  
Cap6 New / expanded authorities

- **Capabilities that will influence force sizing (in order of potential impact)**

- ◆ Cap2 and Cap3 may have the same impact, but
  - Cap2 success depends on building actionable awareness
  - Cap3 acknowledges inevitability of an event, and value of Cap3 in other-than-HLD capabilities
- ◆ Cap6 impacts could be significant if guard/reserve authorities are adjusted
- ◆ Cap5 could imply significant force (re)sizing/rebalancing, depending on CONOPS
- ◆ Cap4 could result in rebalancing organizations, end-strength and skill sets
- ◆ Cap1 is really a policy/ alignment/resource issue, not technology or force structure

Need capability measures.



QDR 2005 identified six key capabilities required to provide Defense of the Homeland in Depth (DHiD).

The order reflects the degree of influence we believe they would likely have on force sizing decisions. In this context, we expect Air and Maritime Domain Awareness and Consequence Management (CM) to have roughly comparable implications for force structure.

Additionally, investments in Consequence Management capabilities would likely provide further value in non-military applications (e.g., environmental incidents).

Consequence management may be a capability that drives force planning to a high degree. Therefore, initiatives to develop metrics to measure that capability should be undertaken as soon as possible. Measures for deterrence capability may be leveraged from work ongoing at STRATCOM.

## WG 5 – Focus Area: Shaping Choices of Countries at Strategic Crossroads



- All QDR capabilities will influence force sizing

- ◆ Shaping to achieve cooperation
  - Security cooperation (training, military to military co-op, etc...) with allies and potential partners
  - Language and cultural awareness training (content, instructors, trainees)
- ◆ Shaping to deter competition and/or attack
  - Persistent surveillance
  - Rapid mobility and power projection
  - Increased prompt global strike
  - Secure broadband into contested areas (GIG)
  - Integrated ballistic and cruise missile defenses
  - Air dominance
  - Undersea warfare
  - Shape and defend cyberspace
  - Joint survivable C2

- Additional shaping capabilities

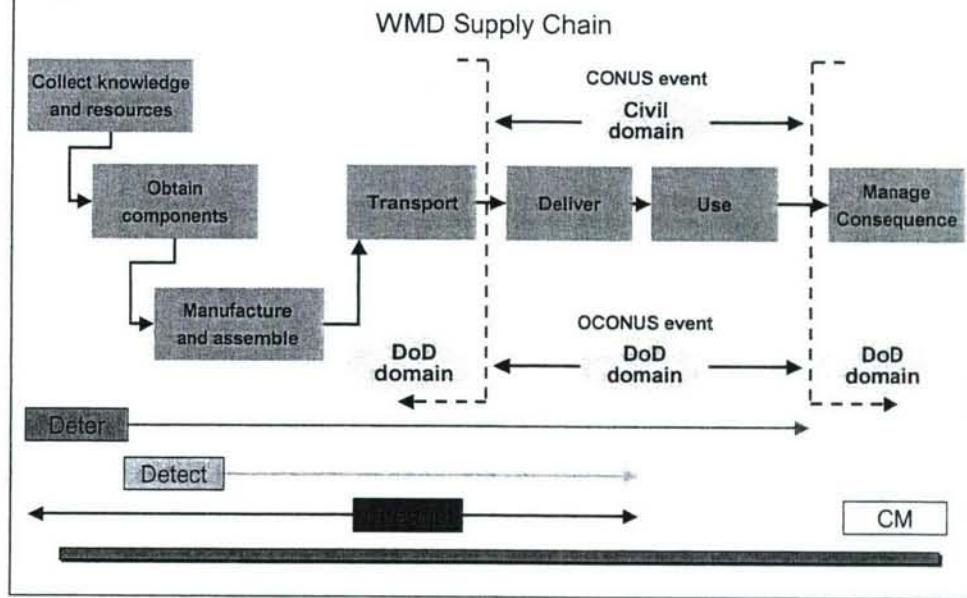
- ◆ Net assessment to support long term planning
- ◆ Effective strategic communications (military, non-military)
  - Use IO to influence risk perception
- ◆ Increased engagement in host countries

Need capability measures.

The WG 5 subgroup team assigned to examine capabilities required to effectively shape countries at strategic crossroads found that force sizing will be influenced by the entire set of capabilities presented in the QDR. Of these 11 key capabilities, this group found four for which they believe measures do not exist. Of note, two of these will require exploration of metrics influenced by the social sciences.

In addition, this subgroup listed several additional capabilities that could enhance the effectiveness of shaping efforts, three of which are listed on this slide. To enable better strategic and long-term planning, better net assessment capabilities are required. Strategic communications capability — to include information operations — may be appropriate to influence our adversary's perception of risk and allow us to influence his decision making.

**WG 5 – Focus Area: Preventing the Acquisition or Use of WMD**  
**Operational Context**

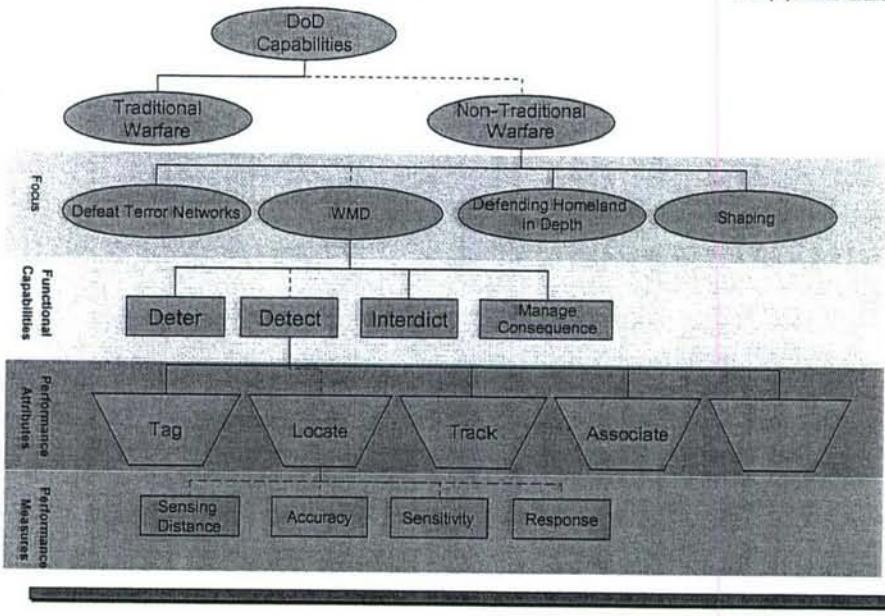


The WMD subgroup team used a systems engineering, process and function driven approach. To provide operational context and a framework for discussion, the group presented a notional supply chain that begins with the gathering of knowledge and materiel, and proceeds through a series of steps ending with CM requirements.

To focus on force sizing implications, the team described the functional capabilities that might be required to address this challenge, including deterrence, detection, interdiction and consequence management. To provide insight to DoD leadership, the group delineated the areas of responsibility (between civil authorities and the DoD, as currently defined) to focus ownership for any capability investment that might be required.

This construct provides the foundation for discussion of a methodology that will permit issue deconstruction followed by cost-benefit and risk analysis. Within this framework, the decision maker can establish priorities (i.e., which part of the supply chain should we focus on) and then balance cost versus risk more effectively.

## WG 5 – Focus Area: Preventing the Acquisition or Use of WMD



After developing the WMD supply chain, the team developed a value hierarchy construct for the WMD focus area. The value hierarchy portrays a potential decision-framing methodology. However, this methodology could be expanded to create an overall value hierarchy that could include all four focus areas in a single value hierarchy. To be complete, the hierarchy requires expansion using experts to identify performance attributes and measures.

The “Focus” element identifies the four QDR focus areas as an organizing construct for the subsequent functions and performance characteristics. These characteristics would require definition such that mission value or stakeholder priorities are explicit.

“Functional Capabilities” are those that support the performance or achievement of a particular focus area. In this example, there is a need to deter, detect, interdict and manage consequences of WMD activities and events. The next level assigns “Performance Attributes” to each functional capability, defining the necessary tasks that must be performed in order to arrive at a particular functional capability. Finally, “Performance Measures” are developed to permit analysis of specific systems or technology solutions.

Adopting an overall approach would permit discussion of the relative value of particular capabilities provide a basis for investment and resource allocation discussions.

## WG 5 – Focus Area: Preventing the Acquisition or Use of WMD



- **Assess the QDR capabilities –**

- ◆ Identify capabilities that will influence force sizing

QDR Capabilities	Deter	Detect	Interdict	Manage Consequence
SOF locate / characterize/ secure	--	--	--	
Locate / Tag / Track	--			
Detect fissile material at standoff range	--	--	--	
Air / maritime / ground interdiction		--	--	
Persistent surveillance over wide areas	--			
HUMINT / language skills / cultural awareness	--	--	--	--
Teams to render safe / secure		--	--	
Non Lethal weapons to secure WMD sites	--		--	--
JC2	--	--	--	
Deploy / sustain / support / protect / redeploy SOF hostile environs	--	--	--	
Shield critical systems / technologies from EMP				--

Detection, interdiction, and management capabilities may enhance deterrence.

Finally, the WMD subgroup considered which of the eleven capabilities highlighted by the QDR report had implications for force planning.

This slide lists each capability, arrayed against functional capabilities derived from preliminary WMD supply chain analysis. Blue boxes (--) indicate that the functional capability will influence force sizing. For example, investment in HUMINT, language skills and cultural awareness would improve our ability to detect WMD as well as manage consequences. Adding SOF capability would improve detection and interdiction ability. In any case, increased capability would provide the ancillary benefit of increasing risk to the adversary, enhancing deterrent capability.

## WG 5 – Conclusions



- **Future makes scenario based planning more important**
  - ◆ Uncertain and dangerous
  - ◆ Complex, intelligent, adaptive threats
- **Larger, more diverse group of decision makers and stakeholders**
  - ◆ Difficult to trade-off between diverse capabilities
  - ◆ Fundamental issue may be balancing risk
- **Non-traditional complexity present new integration challenges**
  - ◆ Many complexities caused by threats, distributed decision making, and very large number of stakeholders
  - ◆ Difficult to integrate priorities across non-traditional security areas
- **Defining functions of each focus areas will help measure, model and simulate QDR capabilities**
  - ◆ We need measures for some of the most important capabilities

Makes Title 10 provider's job more challenging.

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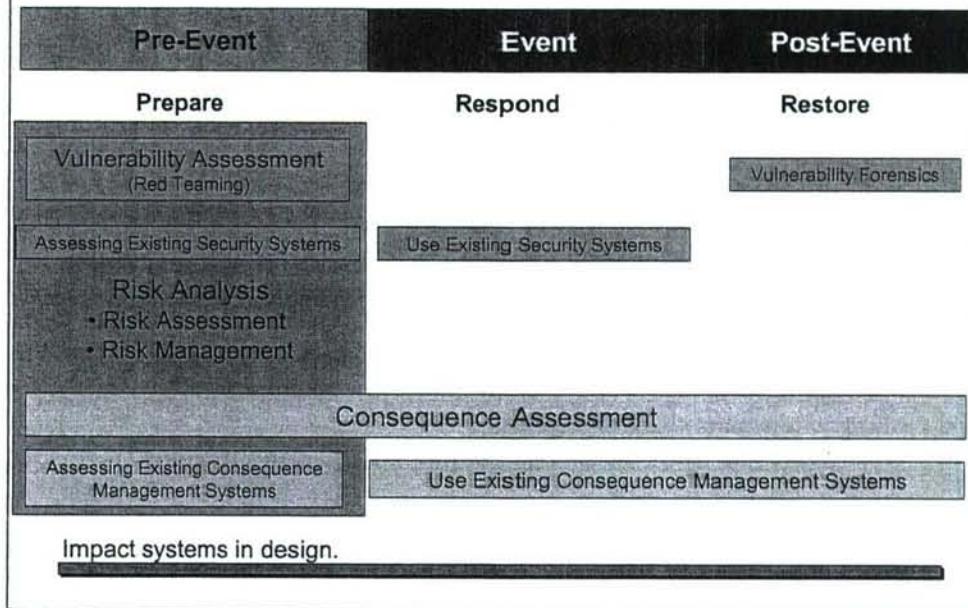
In conclusion, Working Group 5 agreed that the uncertain and potentially dangerous future requires the use of scenario-based planning. The scenarios must be creative enough to enable us to think like our adversaries. The ability to analyze complex and adaptive adversaries will be critical, and analysis augmented by “red cell” insights and the social sciences will be necessary.

Additionally, the group highlighted the increasing complexity of decision making. Competition for scarce resources driven by individual and organizational perspectives and priorities will make trades more challenging.

Integration is critical, particularly in the face of the broad challenges presented by an intelligent, committed adversary employing unconventional methods.

Finally, defining functions will help develop improved measures and models. In order to provide appropriate resources to important capabilities, we need to develop measures and methods to adequately describe potential return on investment.

**Risk Analysis May Be a Useful Framework for Defense Analysis.  
Illustrative Operational Risk.**



Since one of our findings was that risk management will be critical in two of the four focus efforts, we used this slide to introduce the risk management lexicon.

Existing security systems (fences, firewalls, etc.) prevent, identify and reduce known vulnerabilities. These systems may help reduce the probability of success given an attack.

Existing consequence management systems reduce the consequences of an attack given a successful attack.

Risk analysis = risk assessment + risk management. The purpose of risk assessment is to assess risk before an event so we can make risk management decisions to improve our security and consequence management systems.

The standard definitions for these terms can be found at the Society for Risk Analysis (SRA). (2005). "Glossary of Risk Analysis Terms." [http://sra.org/resources\\_glossary.php](http://sra.org/resources_glossary.php)

## WG 5 – Recommendations and Next Steps



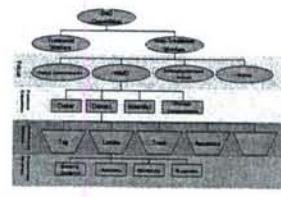
### • Potential Resource Allocation Methods\*

- ◆ New focus on risk analysis methods

QDR Focus Areas	Large Simulations	Model(s)	Benefit/Cost Analysis	Risk Analysis	Gaming
Defeat terrorist networks	Potential in Long Term		FY08 POM & Long Term Goal		
Defend Homeland in Depth				FY08 POM & Long Term Goal	
Shape choices of countries at strategic crossroads		Potential in Long Term			FY08 POM
Preventing the acquisition or use of WMD	FY08 POM & Long Term Goal	FY08 POM		FY08 POM & Long Term Goal	

### • Next steps

- ◆ For each QDR focus area and across the focus areas
  - Use creative new scenarios
  - Define functions
  - Identify capabilities to perform functions
  - Develop measures for each capability
  - Develop models and simulations to calculate measures



\*Caveat – WG 5 did not examine specific models and simulations

A survey of the 27 experts in Working Group 5 produced the results presented in the table above. The challenges of the non-traditional environment will drive us to examine combinations of traditional and newly-developed analytic tools and decision aids. While some of the focus areas can use current operations research techniques, others may require a different perspective — some of which may necessitate education of the decision maker. For example, capabilities required to successfully defend the homeland or prevent use of WMD may be better examined by using risk analysis and value hierarchies as illustrated in previous slides.

Working Group 5 recommends a five step approach to improving analytic support, and by extension, enhancing the ability of the decision maker to make informed choices. This approach would involve use of creative scenarios, well-defined functions, capabilities that support the functions and measures to evaluate performance. Once this precursor work is accomplished, the development of models and simulations should be pursued.





# **Analysis for Non-Traditional Security Challenges: Methods & Tools**

**Military Operations Research Society (MORS)  
Workshop**

**Synthesis Group  
Outbrief**

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This is the Synthesis Group outbrief for the *Analysis for Non-Traditional Security Challenges: Methods and Tools* Workshop held at John Hopkins University Applied Physics Laboratory in Maryland on 21-23 February 2006.

## Agenda



- Workshop goals, panel goals and composition
- Insights on the nature of the problem
- Selected findings, recommendations
- Summary

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The Synthesis Group was formed to look across the other working groups. Our final report brief will follow a different outline.

## Workshop Objectives



- Illuminate users of non-traditional modeling and simulation gaps and deficiencies in the context of the defense security challenges and emerging changes in the defense strategy
- Identify areas of user commonality
- Capitalize on Joint, Service and Agency toolsets and ongoing model development for the larger community
- Develop partnerships to share future M&S

These are the goals for the workshop from the Terms of Reference and as briefed to the MORS Sponsors involved in workshop planning.

## Workshop Guidance



- **Get the right match of stakeholders, technologists and thinkers into each WG**
- **Encourage participation by innovative people with new ideas and new tools**
- **Shape the meeting towards the goal of investing in commonly usable products to advance our ability to aid decision making**

These points were the additional guidance and points of emphasis the Program Committee received from the MORS Sponsors.

## Panel Goals, Objectives, Scope



- **Goals**
  - ◆ Provide an overview of the entire workshop
- **Objectives**
  - ◆ Clarify the nature of the problem by conducting internal panel discussions
  - ◆ Capture the framing issues based on the presentations at the Plenary
  - ◆ Derive key themes, findings, and recommendations from the results of the individual panels
- **Scope**
  - ◆ Focus on support for Strategic/Departmental level decision making
  - ◆ Future challenges and recommendations

By definition, the working groups are not mutually exclusive. The inherent overlaps between the working groups provides synthesis points for integrating the conclusions from each; as well as reducing the probability that major ideas will fall through the cracks between the workshop topics. The Synthesis Group examined cross-group commonalities and insights and developed additional workshop recommendations.

Consistent with the goal to provide an overview of the entire workshop, the Synthesis Group pursued three supporting objectives. First, it sought to clarify the nature of the problem. Second, as a group, it reviewed the presentations from the plenary session for cross cutting issues and themes and used those results to aid in its review of WG findings. Finally, the group derived key findings and recommendations based largely on an integration across the results of the individual working groups.

## Recruiting Was Tough...



***“But I want to be with a real Working Group!”***

As many of you know, members of the Synthesis Group have a day-time job and a night-time job. During the day, each member of the group was embedded in one of the four mission oriented working groups. During off-hours we met to share insights and develop a holistic view of the subject. Thus, recruiting can be difficult, requiring unorthodox approaches.

## Synthesis Panel Composition



- **Renee Carlucci – MCCDC**
- **Sunny Conwell – N81 (Synthesis Panel Co-chair)**
- **Lee Dick, FS – N81 (Workshop Chair)**
- **Jeff Hamman – JHU APL**
- **Jim Harris – AF/A9 (Workshop Co-Chair)**
- **Greg Keethler – Lockheed Martin**
- **Roy Reiss – AF/A9 (Synthesis Panel Co-chair)**
- **Roy Rice, FS – Teledyne Brown Engineering**
- **Vince Roske, FS – Institute for Defense Analyses**
- **Bill Sentlinger – OSD/JDS**

The Synthesis Group was assigned to working groups as shown with some members assigned to float between working groups. Multiple people were assigned to WG 1 and WG 5 since these working groups subdivided into multiple teams to focus on specific topics.

- **Renee Carlucci – WG 3**
- **Sunny Conwell – WG 1**
- **Lee Dick, FS – float**
- **Jeff Hamman – WG 5**
- **Jim Harris – float**
- **Greg Keethler – WG 5**
- **Roy Reiss – float**
- **Roy Rice, FS – WG 4**
- **Vince Roske, FS – WG 1**
- **Bill Sentlinger – WG 1**

## Speaker Perspectives From the Plenary



- **Keynote – VADM Chanik**

- ◆ We are re-balancing future force capabilities
- ◆ “Fighting the Long War” focuses on key points that have not been addressed in traditional warfare analysis — building relationships and early preventive measures. How these are addressed in M&S tools/methods is a critical question
- ◆ In the current security environment success requires integration of all US Government capabilities and greater cooperation with allies and partners
- ◆ The QDR has specific end states desired
  - How are these evaluated using traditional tools and methods?
  - How differently are these non-traditional warfare questions to previous traditional warfare questions?

During the plenary session initiating the event, eight distinguished speakers addressed several key issues.

The following section briefly summarizes perspectives on those issues. It is meant to capture selected, major points articulated by the speakers rather than provide a comprehensive summary of their remarks.

VADM Chanik’s keynote *“Meeting the Nation’s Challenges of Tomorrow How the Operations Research Analyst Can Help,”* provided insights to shape working group discussions.

He also identified five challenges for the participants in the workshop and for the Defense analytic community:

1. Continue to broaden open and collaborative environments to study issues concerning the Department of Defense.
2. Continue the work started in past workshops and the analytical methodology working group.
3. Identify required capabilities to fight our wars in the future.
4. Develop analytical methodologies to analyze non-traditional warfare.
5. Provide a list of gaps in tools and methods for development within the research community.

## Perspectives from the Plenary



- **Applicability of Operations Analysis Techniques - Dr Hanley**
  - ◆ Traditional OA techniques *do apply* to the non-traditional challenges
    - Multidisciplinary teams
    - Analytic Methods: Operational Statistics, Operational Experiments, Analytic Wargaming; Complex Sciences, Military Soft Power (Social and Economic Sciences)
    - "Hemibel thinking" – Factor of 3 improvement
  - ◆ Criteria for investing in simulations of soft military power
    - Internal Validity
    - Usability
    - Extendibility
    - Replication of results
- **Cyber Warfare – Dr Kass**
  - ◆ Cyberspace is the only facet/environment in which the US has peer competitors
  - ◆ It is the only entirely manmade environment that we operate in
- **2006 Quadrennial Defense Review –Col Kelly**
  - ◆ Integrated, augmenting, and complementary analysis
  - ◆ Employ a broad array of analytic methods and tools

## Perspectives from the Plenary



- **Service Perspectives**

- ◆ **Air Force – Dr Jacqueline Henningsen, FS**

- *The Non-Traditional Security Challenge* requires us to think of our enemies and ourselves as a part of a complex system — *With many interdependent parts*
    - To analyze a complex system, we must first understand its behavior — *Not only behavior of the parts...but how they form the behavior of the whole*

- ◆ **Navy – Mr. A.H. Barber III**

- What methods, techniques and tools can be applied to answer questions associated with non-traditional challenges?
    - How do we get trusted results that decision makers are willing to use?
    - Where we do not have accepted methods and tools, how do we fill the gaps?

- ◆ **USMC – Dr. George Akst**

- The inability to assess the interdependency of military, civilian, and multi-national efforts during the conduct of stability operations is the *major analytic shortcoming*
    - Success needs to be clearly defined and translated into quantitative MOEs before analysts can build models

## Perspectives from the Plenary



- **Service Perspectives**

- ◆ **Army – Dr Markowitz**

- Strategy Mix and Integration

- Scenario Mix; Force Management; Force Planning; Acquisition;

- Stationing and Integrated Global Posture and Basing

- Each area requires different analysis techniques

- Common themes: complex environment, non combatants, C4ISR

- **Common Themes and Additional Insights**

- ◆ This is not a new problem but it is still not well understood

- ◆ Need to understand the problem before building the model

- ◆ Success requires integration of all USG capabilities and greater cooperation with allies and partners

One major theme from multiple speakers was that this is not a new problem the DoD faces. It is a problem that the defense analytic community and MORS has addressed before, but the recent past has not been a major analytic focus area. It is also an area that is not well understood and more thought on the nature of the problem, understanding of the decision space, measures of success and metrics is needed before detailed, trusted, models can be built.

Finally, several of the speakers pointed out that successful analysis needs to take into account the capabilities of the other non-defense organizations that play a key role in these non-traditional challenges and scenarios and how their activities integrate with defense activities.

## The Working Groups: An Assessment



- ◆ Did we get we get the right match of stakeholders, technologists and thinkers into each WG?
  - Overall the workshop had a diverse group
  - With diversity comes more time reaching a common frame of reference
  - Involving the other government organizations a work in progress
- ◆ Working Group pre-workshop preparations
  - Catastrophic WG: Stakeholder surveys to frame discussion
  - Deterrence WG: Low response rate a problem
  - Irregular WG: Innovative use of scenarios to focus discussion

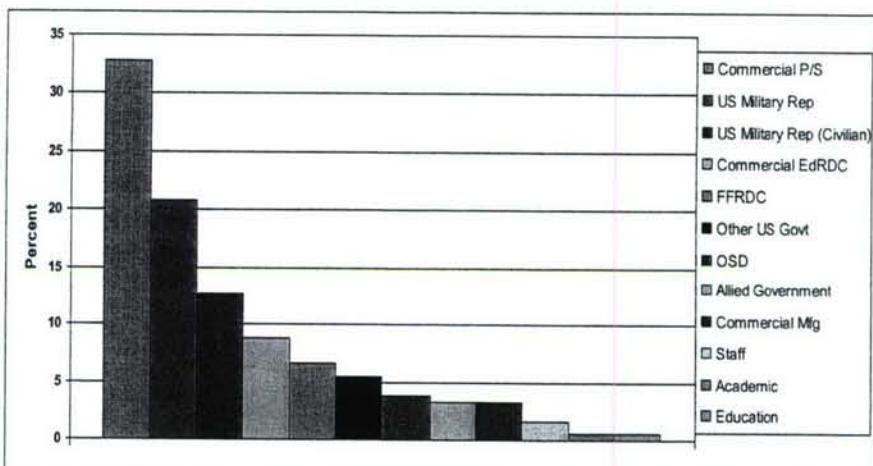
One of the key points of emphasis for the workshop sponsors was to get the right match of stakeholders, technologists and thinkers into each WG and to encourage participation by innovative people with new ideas and new tools.

- The workshop did achieve a diverse group of participants, as shown on the next slide. There were approximately 183 attendees with 83 of them being new to MORS. The organizing committee worked hard to bring in folks from other non-defense agencies, allies and the commercial sector who do not normally work on traditional defense analysis issues.

However achieving a diverse group of participants meant that the working groups needed to spend more time in the first part of their sessions making sure that all of the members had a common set of definitions and frame of reference. In addition, despite the committee efforts, all of the working groups wanted more participation from the non-defense government organizations.

Three of the working groups tried to do innovative pre-workshop preparation. Two tried pre-workshop surveys to help focus their efforts. WG 3 (Catastrophic) found it useful while WG 4 (Deterrence) did not due to a low response rate. WG 1 (Irregular/GWOT) developed a group of scenarios that were used at the workshop. Teams were assigned to analyze each scenario to see what analytic method and tools they might use if assigned a study in that area.

## Attendee Demographics



## The Working Groups: Common themes



- **Scoping DoD mission**
  - ◆ In some cases DoD is supporting organization
  - ◆ Defining capabilities expected from DoD
- **What are decision maker's key issues and what are the suitable measures**
- **Defining interaction with other government, NGOs and international organizations**
  - ◆ Roles and responsibilities
  - ◆ Different organizational structures and cultures
  - ◆ Information and data providers
- **Methods**
  - ◆ Analytic Wargaming
  - ◆ Non-M&S methods (risk analysis, cost-benefit analyst, social networks, game theory)
  - ◆ Integration across an ensemble of models/tools

**Scoping the DoD mission:** The DoD role in many of the non-traditional areas is in support of non-defense organizations. The capabilities required to support or augment other organizations will need to be well defined.

**Key issues:** Analysts need to focus on the key issues and defining the problems and impacts of decisions on resource allocation, rather than rush to develop models. Non-traditional challenges may take more time to develop up front.

**Interactions with non-DoD organizations:** The DoD has collaborated to develop the UJTL (Universal Joint Task List) to provide a common lexicon for defining the capabilities of the Services. There are US government efforts, such as USAID, to collaborate with other governments, IGOs, and NGOs to develop international definitions. The DoD will need to be active in this lexicon development.

The DoD organizational structure with respect to regions of the world is very different from other organizations. For example, DoD has 3 COCOMs that deal with Africa, where most organizations have a unique interaction with Africa.

Data from non DoD organizations will be necessary for NTW analysis. MOAs and MOUs will be needed to establish trusted and protected data sources for this analysis.

**Methods:** Wargaming is a tool that is well-suited for examining issues in NTW. There are analytic methods in other communities that can be applied to this problem space such as risk analysis, systems engineering, or economic models.

DoD analysts have long used a range of models based on physics. However much of the NTW analysis will be based on complex interactions between humans. Even though many models and techniques were discussed, there was a consensus that the NTW solutions will be more comparative rather than absolute and will require reasoning across an ensemble of models, where the models are in different domains (like the components of PMESII).

## The Working Groups: Common themes



- **PEOPLE**
  - ◆ Need more diverse analytic teams with more social science experience
- **DATA**
  - ◆ Where is it? How to acquire? What is available?
  - ◆ Interaction between data, models and metrics
- **V&V**
  - ◆ How to accomplish V&V for new tools
  - ◆ Need to develop ways to accomplish V&V on methods and data

**People:** A common denominator across the working groups was the recognition that the military operations research community (which is currently largely comprised of mathematicians, physicists, ORs, engineers and scientists) will need to be augmented by other disciplines such as sociologists, anthropologists, regional experts, economists, political scientists, and psychologists. It will not be sufficient to leave these disciplines to academia and reach back. We need multi-disciplinary teams within the DoD to work collaboratively on the analytical issues for non-traditional warfare.

**Data:** The physics-based data is well understood by the MORS community. The soft sciences are a new domain. Data mining technologies will need to be incorporated. The design of experiments will be very important. Methods for collecting data will have to be validated. Many data sets will be noisy and different techniques for analysis will be required. Sources that are outside of the norm will be required such as mining newspapers, industry reports, global/regional economic data, web postings, political satire, academic publications, etc. The interactions between data, models and methods will likely be more challenging.

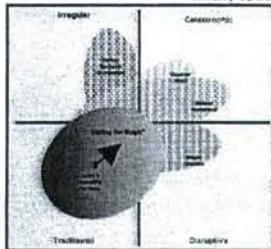
**V&V:** Verification and validation (V&V) was a common theme in working group discussions. One area was the need for reasonable and sufficient V&V of models and the difficulty of accomplishing V&V when there is little real world, historic or test results to form a basis of comparison. A second area of discussion was the need to accomplish V&V of the analytic methods and the supporting data to build the confidence of decisions makers when presented with analysis using new methods and tools and relying on data from that for unfamiliar data sources.

**When evaluating a model, at least two broad standards are relevant. One is whether the model is consistent with the data. The other is whether the model is consistent with the real world. – Kenneth A. Bollen, Structural Equations with Latent Variables**

## The Problem is Not New



- But it does reflect a shift in the DoD's priorities



- What is non-traditional in non-traditional challenges?

- ◆ Interdependence and relationships with other non-defense organizations
- ◆ A complex system with many interdependent parts, influenced by many factors — ours and theirs
- ◆ Importance of perception
- ◆ Increased use of social science methods
- ◆ Less data available (some capabilities can be difficult to measure)
- ◆ Link between methodology, metrics and decision makers

While issues associated with the non-traditional challenges are not new issues they are issues that have not been a high priority for the DoD for a while, until their recent reemergence. As the keynote and other plenary speakers pointed out it does reflect a shift in the DoD's priorities.

The second part addresses a question raised by a member of the Synthesis Group in our initial discussions and by two of the working groups in their discussions. They represent areas that are either not critical to successful analysis of the traditional Major Contingency Operations (MCOs) or are unique to the non-traditional challenges. The relationship with non-defense organizations is critical to analysis on the non-traditional scenarios, in some cases the DoD is the supporting organization and the needed capabilities and definition of success is defined by the supported organization. Many of the new issues require a complex systems approach where it can be difficult to measure success. Much can depend on perception or the ability to change or influence perception. In some cases success is no action or activity. This includes greater use of social science methods and data associated with those methods. New data sources need to be identified and in many cases the data will be more noisy or sparse than more hard data such as weapon system dates that are used for analysis of MCOs.

Finally, as we introduce new methods and tools it will take time for the decision makers to develop the level of understanding and comfort they have in studies using the methods, tools and models they are familiar with from years of seeing the results of studies using the MCO based scenarios.

## In Summary



- **Accomplishments**
  - ◆ The workshop made progress against objectives
    - Review of current tools
    - Identify gaps in skill sets and requirement for more diverse OR teams
  - ◆ To paraphrase the psychiatrist in *Portnoy's Complaint*: "Now, we are ready to begin..."
- **Residual Challenges**
  - ◆ Reach out to a broader community (e.g., Inter-agency and coalition) continue to broaden open and collaborative environments
  - ◆ Regard this workshop as part of a sequence, continue the work started in the past workshops and analytical methodology working group
  - ◆ Continue to develop analytical methodologies to analyze non-traditional challenges
  - ◆ Methodologies to facilitate assessing and balancing risk
  - ◆ VV&A should address methodologies and data as well as tools

The Synthesis Group sought to put the workshop into perspective by generating a scorecard to summarize the positive accomplishments of the event and the residual challenges that confront the community.

**Accomplishments.** All of the working groups recognized the fact that we need to first understand the types of problems we are attempting to solve and the need to step through a 1st order solution process. Models may not be required to solve the problem; but if a model is required, an inventory of the available models is needed. We also have a need to class problems by common characteristics so that we can identify new and different subject matter experts and technologists to assist in the collaborative solution process.

All working groups realized that our brainpower resources must be expanded in to areas where the DoD has typically not used frequently. These areas are in the human behavior, social, behavioral, and economic disciplines. All of the working groups pointed out the compelling need to attract more representatives from the executive departments, state and local government agencies.

However, it must be understood that this constitutes a beginning, not an end. Our status is reminiscent of Philip Roth's Portnoy at the conclusion of his book *Portnoy's Complaint*. After a difficult, soul-wrenching confessional, his psychiatrist concludes the book with the words "Now, we are ready to begin..."

**Residual Challenges.** Since we are now ready to begin, we believe that there are three major initiatives that the community should undertake. First, there is a need to reach out to a broader community to address the non-traditional challenges. This includes enlisting the aid of the inter-agency and alliance/coalition communities. Second, we need to realize this workshop is just one in a sequence of workshops that will help the defense analysis community develop new methodologies, methods, and tools to address the non-traditional challenges. This includes developing methodologies that facilitate assessing and balancing risk and the appropriate V&V for those methodologies that will enable decision makers to quickly develop an understanding of the resulting analysis and confidence in those results.

## Closing thoughts: Quotes from the workshop...



- **Agent Based Modeling:**
  - ◆ "DoD is in the caboose. Most trains don't have a caboose."
- **V&V**
  - ◆ "Some of this may be like measuring 'elephant repellent,' you think it's working because you don't see any elephants."
- **Data Polling**
  - ◆ "Even if you had the data, you wouldn't have confidence: Did they tell you what they thought, or what they thought you wanted them to think, or what they thought their government wanted them to think?"

# **MORS Workshop: Analysis for Non-Traditional Security Challenges: Methods and Tools**

JHU/APL, Laurel, Maryland

21 – 23 February 2006

## **ACRONYMS**

AFRL	Air Force Research Laboratory
AMP	Analysis of Mobility Platform
BAE	British Aerospace
C2	Command and Control
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CAA	Center for Army Analysis
CAPS	Commanders Analysis and Planning Simulation
CATS	Consequence Assessment Toolset
CBRN	Chemical, Biological, Radiological and Nuclear
CBRNE	Chemical, Biological, Radiological/Nuclear, and Explosive
CDC	Center for Disease Control
CENTCOM	United States Central Command
CIA	Central Intelligence Agency
CM	Consequence Management
COA	Course of Action
COCOM	Combatant Commander
COI	Community of Interest
CPB	Cultural Preparation of the Battlefield
CPM	Critical Path Method
DARPA	Defense Advanced Research Projects Agency
DART	Defense Adaptive Red Team (USSTRATCOM)
DCC	DTA Collaboration Center
DCTS/TWS	Defense Collaboration Tool Suite/ InfoWorkSpace
DHiD	Defense of the Homeland in Depth
DHS	Department of Homeland Security
DIAMOND	Diplomatic and Military Operations in a Non-Warfighting Domain
DIME	Diplomatic, Information, Military and Economic
DoD	US Department of Defense
DOE	Department of Energy
DTO	WG 3 - Organization??
DTRA	Defense Threat Reduction Agency
EBW	Entropy Based Warfare
EPA	Environmental Protection Agency
EPICS	Emergency Preparedness Incident Command Simulation
EPS	Engineering Problem Statement
ERIS	Exploratory Regional Insurgency Simulation
ESS	Engagement Simulation System

EUCOM	United States European Command
FDOS	Flexible Deterrent Options
FEMA	Federal Emergency Management Agency
FFRDC	Federally Funded Research and Development Center
GCAM	General Campaign Analysis Model
GIG	Global Information Grid
GWOT	Global War on Terrorism
HITL	Human-In-The-Loop
HLD	Homeland Defense
HPAC	Hazard Prediction Assessment Capability
HSC	Homeland Security Council
I/O	Input/Output (example XML - eXtensible Markup Language)
IBC	Integrated Battle Command
IDA	Institute for Defense Analyses
IGO	Inter-Governmental Organization
IMEA	Integrated Munitions Effect Assessment
IS	Israel
ITEM	Integrated Theater Engagement Model
IWMDT	Integrated Weapons of Mass Destruction Toolset
J8	Joint Staff, Director for Force Structure, Resource, and Assessment
JCATS	Joint Conflict and Tactical Simulation
JDS	Joint Decision Support
JEM	Joint Effects Model
JFCOM	Joint Forces Command
JICM	Joint Integrated Contingency Model
JMEM	Joint Munitions Effects Matrix
JOEF	Joint Operational Effects Federation
JRD3	Joint Rapid Distributed Database Development
JSRTS	Joint State Response Training Simulation
JTLS	Joint Theater Level Simulation
JWARN	The Joint Warning and Reporting Network
JWARS	Joint Warfare Analysis and Requirements System
M&S	Modeling and Simulation
MCO	Major Contingency Operation
MIT	Massachusetts Institute of Technology
MMOG	Massively Multiplayer Online Game (WG 1)
MOA	Memorandum of Agreement
MOE	Measures of Effectiveness
MOU	Memorandum of Understanding
MOUT	Military Operations in Urban Terrain
MSFD	Multi-Service Force Deployment
NBC	Nuclear, Biological and Chemical
NGO	Non-Governmental Organizations
NIH	National Institutes of Health
NORTHCOM	United States Northern Command
NPS	National Planning Scenarios

NSC	National Security Council
NTW	Non-Traditional Warfare
OPS	Operations
OR	Operations Research
OSD	Office of the Secretary of Defense
OSD (P&R)	Office of the Secretary of Defense (Personnel and Readiness)
OSD (PA&E)	Office of the Secretary of Defense (Program Analysis and Evaluation)
PACOM	United States Pacific Command
PERT	Program Evaluation Review Technique
PMESII	Political, Military, Economic, Social, Infrastructure and Information
PSOM	Peace Support Operations Model
QDR	Quadrennial Defense Review
SD JOC	The Strategic Deterrence Joint Operating Concept
SDM	System Definition Matrix
SEAS	Systems Engineering and Analysis Support
SEDP	Systems Engineering Design Process
SIAM	Situational Influence Assessment Model
SOCOM	United States Special Operations Command
SPG	Strategic Planning Guidance
STRATCOM	US Strategic Command
TIC/TIM	Toxic Industrial Chemical/Material
TOPOFF	Top Officials Three Exercise
TSC	Theater Support Command
UJTL	Universal Joint Task List
UK	United Kingdom
US	United States
USAID	United States Agency for International Development
USG	United States Government
USN	United States Navy
V&V	Verification and Validation
VAPO	Vulnerability Assessment and Protection Option
WG	Working Group
WMD	Weapons of Mass Destruction





# Analysis for Non-Traditional Security Challenges: Methods & Tools

**Military Operations Research Society  
(MORS) Workshop**

**Outbrief for**

**JADM-IPT**

**27 February 2006**

## **Agenda**



- Workshop Overview
- Plenary Insights
- WG Selected Findings and Recommendations
- Common Themes and Summary

## Workshop Objectives



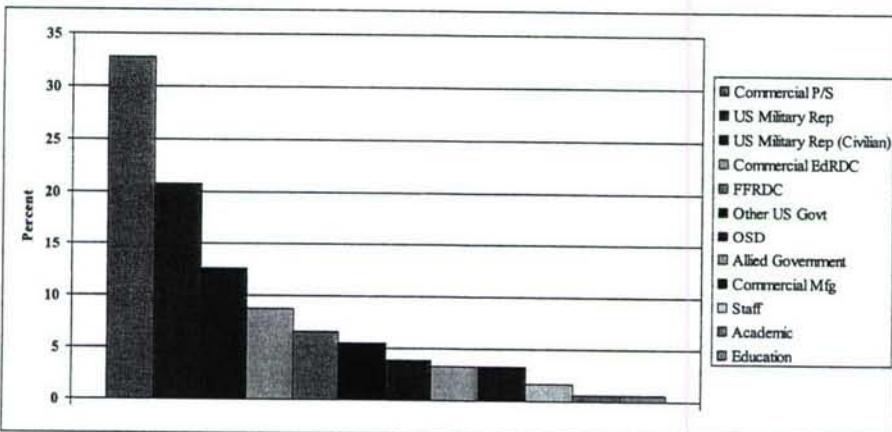
- Illuminate users of non-traditional modeling and simulation gaps and deficiencies in the context of the defense security challenges and emerging changes in the defense strategy
- Identify areas of user commonality
- Capitalize on Joint, Service and Agency toolsets and ongoing model development for the larger community
- Develop partnerships to share future M&S

## Workshop Guidance



- Get the right match of stakeholders, technologists and thinkers into each WG
- Encourage participation by innovative people with new ideas and new tools
- Shape the meeting toward the goal of investing in common usable products to advance our ability to aid decision making

## Attendee Demographics



Total Attendance: 183

## Speaker Perspectives From the Plenary



- **Keynote – VADM Chanik**
  - We are re-balancing future force capabilities
  - “Fighting the Long War” focuses on key points that have not been addressed in previous traditional warfare analysis — building relationships and early preventive measures). How these are addressed in M&S tools/methods is a critical question
  - How can desired QDR end states be evaluated using traditional tools and methods? How differently are these non-traditional warfare questions to previous traditional warfare questions?
- **Cyber Warfare – Dr. Kass**
  - Cyberspace is the only facet/environment that the US has peer competitors
  - It is the only entirely manmade environment that we operate in
- **Applicability of OA techniques – Dr. Hanley**
  - Traditional OA techniques *do apply* to the non traditional challenges
    - Multidisciplinary teams
    - Analytic Methods: Operational Statistics, Operational Experiments, Analytic Wargaming
    - “Hemibelt thinking” – Factor of 3 improvement

## Service Perspectives from the Plenary



- **Air Force**
  - *The Non-Traditional Security Challenge* requires us to think of our enemies and ourselves as a part of a complex system — *with many interdependent parts*
  - To analyze a complex system, we must first understand its behavior — *Not only behavior of the parts...but how they form the behavior of the whole*
- **Navy**
  - What methods, techniques and tools can be applied to answer questions associated with non-traditional challenges?
  - How do we get trusted results that decision makers are willing to use?
  - Where we do not have accepted methods and tools, how do we fill the gaps?
- **Marine Corps**
  - The inability to assess the interdependency of military, civilian, and multi-national efforts during the conduct of stability operations is the *Major Analytic Shortcoming*
  - Success needs to be clearly defined and translated into quantitative MOEs before analysts can build models
- **Army**
  - Strategy Mix and Integration
    - Scenario Mix; Force Management; Force Planning; Acquisition; Stationing and Integrated Global Posture and Basing
    - Each area requires different analysis techniques
  - Common themes: complex environment, non combatants, C4ISR

## Perspectives From the Plenary



- **Common Themes/Additional Insights**
  - This is not a new problem but still not well understood
  - Need to understand the problem before building the model

## WG 1 - GWOT/Irregular



- **Complex topic**
- **Focused on**
  - Action -> Effect -> Results
  - Hard problems involving
    - Human factors, media, influence, populations
    - DIME/PMESII
    - Analysis in support of Headquarters, Combatants, not training etc.
  - Understanding the problem and existing techniques
  - Identifying new approaches that would work

## WG 1 - It's a Process



- **The question**
- **The data**
- **The analysis**
- **The tools**
- **New ideas**
- **Recommendations**

## WG 1 – Get the Question Right



- **Goals and questions are often unclear**
  - We may lack basic frameworks for understanding the problem
    - Use frameworks where they exist
- **You can model anything, but it may ultimately not be very helpful**
- **The question is important**
  - Because soft issue models often need to be customized for the question
  - And data may not exist, or may be complicated and difficult to collect

## WG 1 – We Need Data



- **Lack of data poses a significant problem**
- **Discussed polling as an example**
  - Legal constraints
  - Political constraints
  - Methodological constraints
- **Much of the data we need involves “human” data that is difficult, messy, and controversial to collect**
- **Simulations can only go so far when compared to real world data**

## WG 1 – The Analysis



- **Operations research is the application of *scientific methods to operational problems***
  - We may have to admit that some things do not fall into the category of physical science
  - This means managing the risk associated with decisions in new ways
- **We may want to explore**
  - New decision making models and processes
  - Tools that may not be capable of being validated
  - New techniques, such as multiple instances of models and theories

## WG 1 – The Tools



- **No new or revolutionary tools**
- **Considerable skepticism about any one model's ability to solve a problem**
- **All the existing tools tend to be**
  - Specialized
  - Expert intensive

## WG 1 - Existing Models



Core IW Missions	MORS Workshop Issue Areas	Traditional M&S Tools
Counter – Proliferation		Not Directly Applicable
Counter Terrorism	Counter-terrorism, Terrorist Networks, Critical Infrastructure Protection, Maritime Domain Awareness, Partnering/Shaping, Distributed Operations and Small Unit Operations	Not Directly Applicable
Unconventional Warfare	Small Unit Operations and Distributed Operations	JICM, JWARS? (during latter phases of the UW Campaign Only)
Special Reconnaissance		JICM, ITEM, THUNDER, JTLS, JWARS, COSMOS*
Direct Action	Small Unit Operations and Riverine Operations	JICM, ITEM, THUNDER, JWARS, AMP, JTLS
Psychological Operations		JICM
Civil Affairs Operations		JTLS
Foreign Internal Defense	Foreign Internal Defense, Counter-insurgency, Partner Shaping, Distributed Operations, Small unit Operations and Riverine Operations	JICM, JWARS, JTLS
Information Operations		ITEM, THUNDER

\* COSMOS is a mission level ISR model

## WG 1 - Unconventional Tools



Core IW Missions	IW M&S Tools	Traditional M&S Tools
Counter – Proliferation	Direct Combat Model (DCATS)	Not Directly Applicable
Counter Terrorism	PMESH (SEAS – VIS, ERIS) Direct Combat Model (DCATS)	JICM, JWARS, JTLS Not Directly Applicable
Foreign Internal Defense	PMEBII (SEAS – VIS, ERIS, MIT System Dynamics Model, Agile, ISOF, SOTW, PDOM, MASON, CASS, Foreman, SIAM, ERIS, IBC, Diamond-US) Direct Combat Model (DCATS)	JICM, JWARS, JTLS
Special Reconnaissance	Direct Combat Model (DCATS) Pythagoras	JICM, ITEM, THUNDER, JTLS, JWARS, COSMOS*
Direct Action	Direct Combat Model (DCATS)	JICM, ITEM, THUNDER, JWARS, AMP, JTLS
Psychological Operations	PMESHII (SEAS – VIS, Advertising, Psychological, Political, etc), SOF Behavioral Analysis Tool (Pythagoras)	JICM
Civil Affairs Operations	PMESII-TBD	JTLS
Unconventional Warfare	PMESH (SEAS – VIS, MIT System Dynamics Model, Agile, ISOF, SOTW, PDOM, MASON, CASS, Foreman, A Force More Powerful, SIAM, ERIS, IBC) Direct Combat Model (DCATS) 12 Commercial Wargame Derivatives (HOG, COCOM, Diamond-US, EXFOR, EXFOR, Inform, SimuStrate, Stability Model)	JICM, JWARS? (during latter phases of the UW Campaign Only)
Information Operations	PMESII-TBD (SEAS – VIS, Advertising, Psychological, Political, etc), SOF Behavioral Analysis Tool (Pythagoras)	ITEM, THUNDER

Tools:	Green = On hand Tool Blue = Potential Tool \$ = Tool requiring validation and development effort Purple = Candidate Tool requiring further assessment Red = Future capability
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\* COSMOS is a mission level ISR model

## WG 1 – New Stuff



- **Games as tools**
  - What makes a game helpful?
  - Scenario-based planning, seminar wargames, MMOGs?
- **Learn from other communities**
  - Computational social science
  - Commercial
    - Interface
    - Usability, flexibility, agility
    - Focus
- **Data mining tools**
  - Figure out what they're good for

## WG 1 - What Needs to be Done



- Frameworks/paradigms for Irregular Warfare Analysis
- Irregular Warfare M&S Evaluation Criteria
- Test Cases
- Irregular Warfare Scenarios
- MOEs
- Data
- Irregular Warfare M&S at the Campaign Level
- VV&A
- Analyst (and Consumer?) training
- Prototype cross-cutting studies
- Best of breed approach to model improvement

## WG 1 – A Few Suggestions



- **Change in the *consumption* of the analysis may be the “killer app”**
  - Develop ways to deal with uncertainty in the inputs and results
  - Develop ways to **account for and balance risk** involved in different experimental approaches and outcomes
- **Consider expanding the role of wargames as tools that support decision making**
  - But they have to be done right
  - And you have to balance them with models
- **Learn to use range of outcomes provided by multiple independent analytical approaches**

## WG 1 – Recommendations



- **Getting the question and the framework right is important - and relatively inexpensive**
  - But it can take time, and iteration
- **Examine the possibility of collecting real-world data to support decisions**
- **Examine groups of models**
- **Research the use of games/scenario planning/ commercial techniques to support decision making**

## WG 1 – More Recommendations



- Examine new ways to validate models, and find ways to deal with what traditionally cannot be validated
  - Any model that deals with human decision making
  - While they can not be validated they can be used to inform and support decision making
  - Traditional assumptions of reproducibility and traceability may need to be replaced with transparency and acceptance of judgment
- Examine thinking about the role of modeling, and the need for scientific answers for questions that may have no basis in physical science
  - May need to *accept more risk* in this area

## WG 3 – Catastrophic



- **Catastrophic Homeland Events:** Man-made or naturally occurring events involving significant loss of life and significant social/political/economic/psychological effects: e.g. large National Planning Scenarios (10KT nuke, chlorine tank, plague, anthrax, large natural disasters)
  - COI: NORTHCOM, PACOM, Services, DTRA, National Labs, DHS (including Coast Guard, FEMA), HSC, EPA, DOE
- **Catastrophic Counter-WMD Events:** WMD interdiction, counter-proliferation, deter/defeat the use of WMD by state and non-state actors
  - COI: STRATCOM, Services, Regional COCOMS, DTRA, National Labs, DOE
- Significance =  $f$  (physical, economic, social, political and psychological effects, level of effort, duration)
- Some key unresolved issues
  - Roles and relationships (Lead Federal Agency, Title 10/32, authority)
  - Lack of coordination, integration, inter-operability
  - Immature data, methods, tools in some areas

## WG 3 – Current Analytic and M&S Capabilities



- **Current capabilities**
  - Engineering level: Robust individual models: DTRA Suite, CAPS
  - Tactical/operational level: EPICS, JCATS, IWMDT
  - Campaign level: Legacy models (ITEM), but these are not tailored for domestic catastrophic events
  - Training models: Significant lack of simulators/stimulators and facilities
- **Applications/examples – many stand alone tools: multiple tools often required to assess a scenario**
  - Defense Collaboration Tool Suite/InfoWorkSpace (DCTS/IWS)
  - Hazard Prediction Assessment Capability (HPAC)
  - Consequence Assessment Toolset (CATS)
  - Integrated Munitions Effects Assessment (IMEA)
  - Vulnerability Assessment and Protection Option (VAPO)
  - Traditional campaign analysis/mission level tools re-purposed to assess catastrophic scenarios

## WG 3 – On-going Enhancements



- **Selected engineering and system level tools**
  - Joint Effects Model (JEM): Predict and track NBC and Toxic Industrial Chemical/Material (TIC/TIM) events and effects
  - Joint Operational Effects Federation (JOEF): M&S for warfighters and planners to accurately predict CBRNE effects
  - The Joint Warning and Reporting Network (JWARN): Comprehensive analysis and response capability to minimize the effects of NBC attacks, accidents and incidents

### **DTRA will begin to spiral Integrated WMD Toolset (IWMDT) FY06**

- **DTRA Collaboration Center (DCC) - Common architecture that supports CBRNE data fusion from disparate sources supporting Situational Awareness, Systems Engineering and capability development: Initial operational capability FY06**

### **DTRA partnering with Services, COCOMS, Allies, Labs**

## WG 3 – Analysis Gaps and Deficiencies



- **Key stakeholders and decision makers**
  - USG (Inter-agency) ◆ DoD/Services/COCOMS ◆ Local governments
  - Allies ◆ Coalitions ◆ Industry
  - State/territorial Govts/NG ◆ National/private labs ◆ First responders
- **Key analysis gaps and deficiencies**
  - Perceived lack of objective goals, defined responsibilities, actions/resources reflecting stated priorities
  - Need for improved interagency cooperation, collaboration and data sharing
  - Insufficient understanding of complex, primary effects and secondary effects (political, economic, social, psychological)
  - Little quantification of local, state, federal, DoD, and international response capabilities
  - Immature and/or non-existent operating procedures, data, tools for evolving mission and requirements
  - Barriers to sharing data, plans (classification issues, terminology, ontology)
- **Commonalities between stakeholders**
  - Desire for comprehensive, systematic, interagency analysis
  - Desire for integrated, tactical/operational tools
  - Need to plan for response and future investments
  - Mission focus

## WG 3 – Key M&S Shortfalls and Gaps



- **Data**
  - Lack of data on local, state, other federal, NGO, international agency capability
  - Biological threats, retransmission, mortality, etc.
  - CBRN effects (lack of current/empirical test data)
- **CONOPS**
  - Desired response over time
  - Metrics
  - Translation of DoD capabilities to HLD employment
    - Pre-event (detect, deter, prevent capabilities)
    - Post-event (consequence management)
  - Apportionment of tasks across services
- **Methods/Tools**
  - Model integration/synergy (output of one model not always useable by others to provide useful/meaningful output)
  - Catastrophic models (e.g. Biological)
  - Empirical based models
  - Socio-economical, psychological, and political aspects
  - Integrated M&S “pyramid,” particularly at higher levels

## WG 3 – Potential Solutions



### • Data/CONOPS

- DHS development of a database of state and local capabilities (Target Capabilities List)
- Establish proponents for interagency data collection for engineering to campaign level analyses.
- Development/assessment of appropriate Analytic Agenda scenarios and baselines
- Leverage JFCOM Experimentation, Joint Training, and Joint Center for Operational Analysis events/processes for
  - Development of Combating WMD/"Catastrophic" analytical tools/methods.
  - Relevant data (e.g., Joint Rapid Distributed Database Development – JRD3)
  - Potential M&S/analytical solutions/needs derived through experimentation

### • Methods/Tools

- Facilitated war games (EPICS – Emergency Preparedness Incident Command Simulation, JSRTS - Joint State Response Training Simulation, TOPOFF Ex)
- DTRA's fielding of an integrated GIG-accessible suite of CBRNE tools.
- Enhancements to campaign models (ITEM to link IWMDT)
- Commercial game adaptations/gaming engines (e.g. SimCity, Delta3D)
- Potential partnerships for new M&S/data development: DTRA, DHS (including Coast Guard, FEMA), National Guard Bureau, JFCOM, NORTHCOM, STRATCOM, UK, Canada, Service labs (AFRL), industry.

## WG 3 – High Priority Analytic M&S Needs



### Focus on data and establishing an M&S Community of Interest

#### • Data

- Establish a list of questions for catastrophic events requiring analysis (esp. COCOM needs)
- Collect exercise and operational data: Unit commitment, deployment timeline, activities, duration of commitment
- Collect war game results: C2 relationships, roles, CONOPS, metrics, need for DoD forces, Title 10/32 relationships
- Begin to re-validate applicability of basic engineering data (lab testing for CBRNE)
- Develop biological warfare/contagious disease data: Retransmission, morbidity, etc.
- Follow up on DHS efforts to develop systematic, comprehensive development of data on local/state response capability
- Support common data standards (metadata)

#### • Methods

- Increased catastrophic scenario involvement in analytical agenda products
- Support the conduct of facilitated war games to develop CONOPS, concepts, metrics and clarify responsibilities
- Support SPG tasker to assess large consequence management events

#### • Tools

- Assess DTRA Collaboration Center ability to support analytical requirements
- Establish an interagency "HLD M&S Community of Interest" to refine requirements and integrate effort

## WG 3 – Recommendations



- **Specific to WG area**
  - Develop databases and sources for that data
  - Conduct analytically supported exercises, wargames and studies to refine CONOPS, metrics
  - Develop an active and robust interagency M&S Community of Interest
  - Consider redefining "catastrophic" as two missions areas
    - Pre-event (prevent, deter, defeat)
    - Post-event (consequence management)
- **Overall to Non-Traditional Challenges**
  - Improve communications between all stakeholders by increased focus on Non-traditional challenges in MORS, JCAC, and other joint and inter-agency forums
  - Develop M&S Communities of Interest for each of the sub-areas
  - Reapportion M&S funding from traditional to non-traditional models
  - Renew emphasis on analytically supported war gaming
  - Refocus the analytic agenda on non-traditional scenario development and analysis
  - Data-mine DTOs, goals, objectives, and funding profiles
- **Other comments**
  - Need to support inter-agency participation
  - Need to recognize that significant policy and legal issues remain unresolved
  - If the next 9-11 or OIF stability operation happens, will we be able to say we've done our best to plan and prepare?

## WG 4 – Focus Questions



- How can analysts *characterize and measure uncertainty* concerning deterrence?
- How can deterrence analysts *determine and manage second- and third-order effects* in deterrence analysis?
- How can analysts *estimate the magnitude of an adversary's response* to a proposed friendly deterrent action? Methods exist to determine the general response (e.g., favorable, unfavorable). This question concerns: "How favorable?" or "How unfavorable?"

## WG 4 – Structure



- Stage Setting
  - DoD Strategic Deterrence Concept
- Problem/Discussion
  - Deterrence Assessment Framework
  - Effects in the Cognitive Domain
    - Discussion: *Measuring Uncertainty*
  - Understanding Chinese Thinking
  - Gauging Adversary Response
    - Discussion: *Adversary Response*
  - Planning and Integrating Deterrence
    - Discussion: *2nd and 3rd Order Effects*
- Synthesis
  - Problem Description
  - Methods and Tool Availability
  - Recommendations

## WG 4 – Defining Deterrence



**Definitions  
are important.**

- **Scope of deterrence today**
  - Ends: Beyond the most dire threats
  - Ways: Beyond coercion to include inducements
  - Means: Beyond military to include non-military (inter-agency)
- **Specifying the problem(s)**
  - Coercion
    - Basic, extended, intra-war, compellence
  - Inducement
    - Engagement (alliances, coalitions), cooperation (international organizations), assurance
- **Inclusion of inducements expands deterrence into the realm of influence**
  - MOEs and analysis for each of these may different
  - Perception by others may be different (assume deterrence is coercion)

## Government Stakeholders & Roles in Developing Deterrence Policy & Plans



- **USG: NSC, Inter-Agency, IC, Congress**
  - *National objectives*: National Security Strategy+
  - Develop policy
  - Prioritization and allocation of resources
- **DoD**
  - Military objectives: National Military Strategy
  - Develop policy
  - Issue guidance: TSC guidance, CPG, SPG
  - Prioritization and allocation of resources
- **STRATCOM**
  - Develop global deterrence plan
  - *Synchronize deterrence planning* in other plans
- **Other COCOMs**
  - Regional Commands, including NORTHCOM: Develop regional deterrence plans
  - SOCOM: Develop transnational deterrence plans

**Roles are important.**

## WG 4 – Deterrence



- **Workshop Insights for the *Global Deterrence Concept***
  - Definition
  - Scope
  - Cyber-deterrence
  - Non-state actors
  - Communication of deterrence actions
  - Implementation and planning
  - Costs of deterrence to the US

## WG 4 – Deterrence



### Attacking the Deterrence Analysis Problem

#### Dimensions/factors

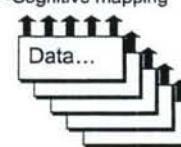
- Players (includes capabilities and limitations)
- Decisions/actions
- Competition/cooperation
- Deterministic/stochastic
- Goals/objectives (single v multiple, Political, econ, mil?)
- Payoffs (+/-, Costs, Benefits) reduce prob of achieve, reduce benefits/increase costs, preference ordering
- Stages/phases
- Strategies (risk averse, mini-max, max-min)
- Interactions/Influences (2nd, 3rd order effects)
- Others.....

Match with...



#### OR Methodologies (Suite)

- Dynamic programming (stochastic or deterministic)
- Game theory – (> 2 person), (non 0-sum), (multi-stage)
- Experimental gaming
- Influence diagrams
- Cost-benefits analyses
- Risk analysis ( $p[\text{event}] * \text{consequence}$ )
- Decision trees/decision analysis (Value, Utility)
- Cognitive mapping



Difference  
Today  
- Who  
- What  
- How  
- Context

Application of Methodology depends on the dimensions AND the question being asked or the decision to be made!

Appropriate question: Do certain actions contribute (detract from) deterrence or stability?

Bad question: What is the probability that action X will deter actor Y from doing Z?

## OR Tool Availability



Different scenarios require different tools:  
Scenario A: strategic nation-state WMD problem.  
Scenario B: Non-state actor WMD problem.

Does not capture:  
- the effectiveness of each particular tool.  
- the priority of analytic need.  
- the need for data.

Methods	Example Tools	Problem Definition			Direct Effects		2nd & 3rd Order Effects		Uncertainty	
		Scope and Boundary [POI, Objectives]	Stakeholder Analysis	Needs Analysis	Identifying 2nd and 3rd order effects	Adversary Decision Making Process (How does he decide?)	Assessing Adversary Response (How is he affected?)	Assessing Adversary Response (How much is he affected?)	Temporal (future options)	Character
Mathematical Programming	Dynamic (stochastic or deterministic)					X			X	X
Network Analysis	Nodal analysis, belief networks						X	?		X
Risk Analysis	risk maps								X	X
Cost-benefits Analysis	cost-benefit ratio					X				
Influence Analysis	causal diagrams, agent-based models	X	X	X	X		X	X	X	X
Decision Analysis	decision trees, prospect approaches					X	X		X	X
Game Theory	> 2 person, non 0-sum, multi-stage					X				
Experimental Gaming	SME, Deterrence gaming, roleplaying				X	X	X	X	X	X
Organizational Effectiveness	goes tree, cognitive mapping		X							
	functional decomposition	X		X	X					
	VO modeling	X		X	X					
	basic research	X		X	X	X				
	brainstorming	X		X						

## OR Tool Availability



Methods	Problem Definition			Direct Effects		2nd & 3rd Order Effects		Uncertainty
	1. Problem (SIT)	2. Analysis	3. Synthesis	4. 2nd and 3rd order	5. Decision-Making (how does it decide?)	6. Primary Response (what is the primary effect?)	7. Magnitude of 7. Responses (how much) 8. Space, regional, global	
Mathematical Programming								
Network Analysis								
Risk Analysis								
Cost-benefits Analysis								
Influence Analysis								
Decision Analysis								
Game Theory								
Experimental Gaming								
Organizational Effectiveness	points tree, cognitive mapping		x					
	functional decomposition	x		x	x			
	VO modeling	x		x	x			
	basic research		x		x		x	
	brainstorming	x		x				

## WG 4 – Points to Consider



- **Problem Definition**
  - Problem sufficiently scoped; work needed to bound the problem (All deterrence, or just strategic deterrence? All forms of influence?)
  - How do we account for the dynamic nature of the problem? (...the "wicked" nature...)
- **Metrics**
  - Are we asking the right questions to guide metrics development? (What are the metrics?)
  - What are the questions that should drive the development of metrics?
- **Data**
  - Lack of relevant data drives need for new methods to impact decisions in a timely manner
  - Some tools should work given unrealistic data requirements

## WG 4 – More Points to Consider



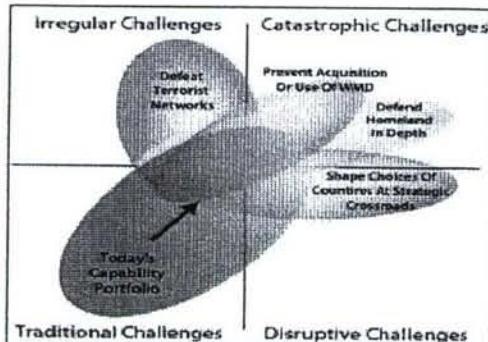
- **Methods**
  - Allow for competitive analysis; value of outsourcing analysis; avoiding single points of failure
  - Impact of SME and expert opinion as data source
  - Need for inter-disciplinary team (include IA, multi-national)
  - Need for methods to validate analysis
  - Methods to address the role of ambiguity in deterrence
  - From plenary: Methods must be usable, understandable, extendable, and replicable
  - How do we account for learning by unidentified (i.e., potential) adversaries?
- **MORS**
  - Provide mentor to work with each WG
  - Accommodate and seek-out IA participation

## WG 4 – Recommendations



- **Recommendations**
  - To Deterrence WG/STRATCOM
    - Implement suggestions throughout this brief
  - To Sponsors
    - DoD: Carefully define and specify scope and roles concerning deterrence
    - Drive development of deterrence policy, analysis and planning across USG, not just within DoD
    - Sponsor focused (and integrated?) research in difficult areas
  - To MORS
    - Provide a mentor to each WG (ala Rist mentors)
    - Adjust MORS to accommodate/encourage greater IA participation
    - Hold MORS Workshop on Influence Operations
      - Will help define boundaries
    - Sponsor MORS competition for thorny problems

## WG 5 – Decision Making and Integration



As the diagram shows, the Department is shifting its portfolio of capabilities to address irregular, catastrophic and disruptive challenges while sustaining capabilities to address traditional challenges.

QDR, page 19

- **Framework for Analysis for each of 4 QDR focus areas**

- Characterize future (2025)
  - Range of operations that our forces may be required to support
- Identify decision making and integration questions
- Assess QDR capabilities
  - Identify capabilities that will influence force sizing
  - Identify or develop measures for force sizing capabilities

- **How would this change the joint analytic agenda**

- Time phase

## WG 5 - Conclusions



- **The future makes scenario based planning more important**
  - Uncertain and dangerous
  - Complex, intelligent, adaptive threats
- **Larger, more diverse group of decision makers and stakeholders**
  - Difficult to trade-off between diverse capabilities
  - Fundamental issue may be *balancing risk*
- **Non-traditional complexity presents new integration challenges**
  - Many complexities caused by threats, distributed decision making, and very large number of stakeholders
  - Difficult to integrate priorities across non-traditional security areas
- **Defining functions of each focus areas will help measure, model and simulate QDR capabilities**
  - We need measures for some of the most important capabilities

Makes Title 10 provider's job more challenging.

## WG 5 - Recommendations and Next Steps



### • Potential Resource Allocation Methods\*

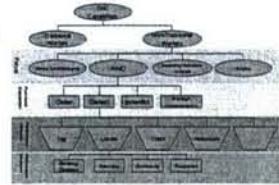
- New focus on risk analysis methods

QDR Focus Areas	Large Simulations	Model(s)	Benefit Cost Analysis	Risk Analysis	Gaming
Defeat terrorist networks	Potential in Long Term		FY08 POM & Long Term Goal		
Defend Homeland in Depth				FY08 POM & Long Term Goal	
Shape choices of countries at strategic crossroads		Potential in Long Term			FY08 POM
Preventing the acquisition or use of WMD	FY08 POM & Long Term Goal	FY08 POM		FY08 POM & Long Term Goal	

\* Caveat – WG 5 did not examine specific models and simulations.

### • Next steps

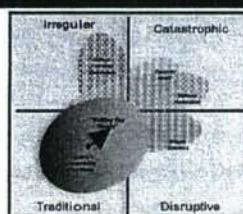
- For each QDR focus area and across the focus areas
  - Use creative new scenarios
  - Define functions
  - Identify capabilities to perform functions
  - Develop measures for each capability
  - Develop models and simulations to calculate measures



## The Problem is Not New



- But it does reflect a shift in the Department's priorities



- What is “non-traditional” in the non-traditional challenges?
  - Interdependence and relationships with other non-defense organizations
  - Link between methodology, metrics and decision makers
  - A complex system with many interdependent parts, influenced by many factors – ours and theirs
  - Importance of perception
  - Less data available (increased use of social science methods)
  - Some capabilities can be difficult to measure

## The Working Groups: An Assessment



- **Did we get the right match of stakeholders, technologists and thinkers into each WG?**
  - Overall workshop had a diverse group
  - With diversity comes more time reaching a common frame of reference
  - Involving other government organizations and agencies is still a challenge
- **Working Group pre-workshop preparation**
  - Catastrophic WG: Stakeholder survey's to frame discussion
  - Deterrence WG: Low response rate a problem
  - Irregular WG: Innovative use of scenarios to focus discussion

## The Working Groups: Common themes



- **Scoping DoD mission**
  - In some cases the DoD is the supporting organization
  - Defining capabilities expected from the DoD
- **What are decision maker's key issues and what are the suitable measures?**
- **Defining interaction with other governments, NGOs and international organizations**
  - Roles and responsibilities
  - Different organizational structures and cultures
  - Information/data providers
- **Methods**
  - Analytic wargaming
  - Non-M&S methods (risk analysis, cost-benefit analyst, social networks, game theory)
  - Integration across an ensemble of models/tools

## The Working Groups: Common themes



- **People**

- Need more diverse analytic teams with more social science experience

- **Data**

- Where is it? How to acquire? What is available?
  - Interaction between data, models and metrics

- **V&V**

- How to accomplish V&V for new tools
  - When evaluating a model, at least two broad standards are relevant. One is whether the model is consistent with the data. The other is whether the model is consistent with the real world. – Kenneth A. Bollen, Structural Equations with Latent Variables

## Scorecard



- **Accomplishments**

- The Workshop made progress against these objectives
    - Review of current tools
    - Identify gaps in skill sets and requirement for more diverse OR teams
  - To paraphrase the psychiatrist in *Portnoy's Complaint*: "Now, we are ready to begin..."

- **Residual Challenges**

- Reach out to a broader community (e.g., Inter-agency, coalition) continue to broaden open and collaborative environments
  - Regard this workshop as part of a sequence, continue the work started in the past workshops and the analytical methodology working group
  - Continue to develop analytical methodologies to analyze non-traditional challenges
  - Methodologies to facilitate assessing and balancing risk
  - VV&A should address methodologies and data as well as tools

## The Workshop Message



- While there is some new tool development ongoing, we are really in the question definition, data gathering and methodology development phase for Non-Traditional Analysis
- We need to open the lens and reach out to other disciplines and involve non-DoD agencies in the process

## The Road Ahead



- Opportunities Identified for Sponsors
- JADM SC Outbrief 2 March
- Follow-on Navy APL Task
- STRATCOM Deterrence JOC rewrite
- March IDA Irregular Workshop
- March Analysis M&S Master Plan Workshop
- DTRA WMD Workshop
- DRTA technical paper on combating WMD for *PHALANX* to describe new missions and required supporting analysis
- March Loose Nuke MSFD Conference Methodology WG
- April Tholian WEB Wargame
- April CBP II MORS Workshop
- June 74th MORSS
  - Special Session Workshop Briefout
  - WG papers (classified & unclassified)
- Need for Follow-on Workshop???



## **Analysis for Non-Traditional Security Challenges: Methods & Tools**

**Workshop Out Brief For  
JADM Steering Committee  
6 April 2006**

**Sunny Conwell  
N816 WCM Lead**



**MORS Workshop: "Analysis for  
Non-Traditional Security Challenges"  
21-23 February 2006**



- Co-sponsored by US Navy (N81) and US Air Force (HQ/A9) at the Johns Hopkins University/Applied Physics Lab
- Participants: Representatives from OSD, Joint Staff, Services, COCOMs, allied nations, industry, academic groups
- Forum: Community review of tools, technologies, and methodologies that enable the analysis of non-traditional warfare
- Purpose: Match stakeholder analytic gaps with potential model or tool solutions
- Goal: Improve DoD models and tools used to support analysis of irregular, catastrophic, and disruptive threats

## Workshop Leadership



### Sponsors

- Dr. Jacqueline Henningsen, FS, USAF
- Mr. A.H. Barber III, FS, USN

### Speakers

- Keynote: VADM Chanik (DJ8)
- Cyber Warfare: Dr. Kass (CSAF)
- OA Techniques: Dr. Hanley (IDA)
- Service and OSD Gaps and Needs:
  - Mr. Barberl, USN N81
  - Dr. Henningsen, FS, USAF A9
  - Dr. Markowitz, USA CAA
  - Dr. Akst, USMC MCCDC
  - COL Pat Kelly, OSD-P

### Co-Chairs

- Mr. Lee Dick, FS, USN N81
- Dr. Jim Harris, USAF A9

### WG-1: Irregular/GWOT

#### Co-Chairs:

Dr. Ed McGrady, CNA  
Mr. Mike Ottenberg  
OSD-PAE/ATL

### WG-3: Catastrophic

#### Co-Chairs:

Dr. Al Sweetser, OSD-PA&E  
Mr. Walt Zimmers, DTRA  
Mr. Don Clements, OSD-PA&E

### WG-4: Deterrence

#### Co-Chairs:

LTC Steve Reise,  
STRATCOM  
Mr. Mark Reid, MITRE

### Synthesis

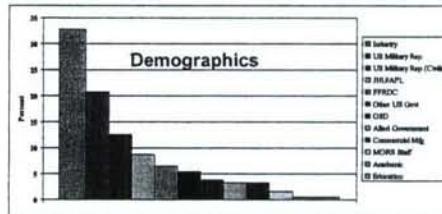
#### Co-Chairs:

Mr. Roy Reiss, HQ/A9  
Ms. Sunny Conwell, N81

### WG-5: Decision Making & Integration

#### Co-Chairs:

Dr. Greg Parnell, FS, USMA  
Mr. Steve Richter, JHU/APL



## WG 1 – Irregular/GWOT



- Getting the question and the framework right is extremely important — and relatively inexpensive
- Examine the possibility of collecting real-world data to support decisions
- Research the use of *games/scenario planning/commercial techniques* to support decision making
- Examine new ways to validate models, and find ways to deal with what traditionally cannot be validated
  - Any model that deals with human decision making
  - While they can not be validated they can be used to inform and support decision making
  - Traditional assumptions of reproducibility and traceability may need to be replaced with *transparency* and *acceptance* of judgment
- Examine thinking about the role of modeling, and the need for scientific answers for questions that may have no basis in physical science
- May have to reason across an ensemble of models

## WG 3: Catastrophic



Consider redefining Catastrophic as two missions areas

1. Pre-Event (Prevent, Deter, Defeat)
2. Post-Event (Consequence Management)

### • Tools

- Assess STRATCOM sponsored DTRA Collaboration Center ability to support analytical requirements
- Establish an interagency HLD M&S Community of Interest to refine requirements and integrate effort

Potential partnerships for new M&S/data development: DTRA, DHS (including Coast Guard, FEMA), National Guard Bureau, JFCOM, NORTHCOM, STRATCOM, UK, Canada, Service labs (AFRL), industry

## WG 4 – Deterrence



### Attacking the Deterrence Analysis Problem

#### Dimensions/factors

- Players (including capabilities and limitations)
- Decisions/actions
- Competition/cooperation
- Deterministic/stochastic
- Goals/objectives (single vs multiple, Political, economic, military?)
- Payoffs (+/-, Costs, Benefits) reduce prob of achieve, reduce benefits/increase costs, preference ordering
- Stages/phases
- Strategies (risk averse, mini-max, max-min)
- Interactions/Influences (2nd, 3rd order effects)
- Others.....

#### OR Methodologies (Suite)

- Dynamic Programming (stochastic or deterministic)
- Game Theory – (> 2 person), (non 0-sum), (multi-stage)
- Experimental Gaming
- Influence Diagrams
- Cost-benefits Analyses
- Risk Analysis ( $p[\text{event}] * \text{consequence}$ )
- Decision Trees/Decision Analysis (Value, Utility)
- Cognitive Mapping



Difference Today  
- Who  
- What  
- How  
- Context



Application of Methodology depends on the dimensions AND the question being asked or the decision to be made!

#### Recommendations To Sponsors

- DoD: Carefully define and specify scope and roles concerning deterrence
- Drive development of deterrence policy, analysis and planning across USG, not just within DoD
- Sponsor focused (and integrated?) research in difficult areas

STRATCOM: Workshop output will directly contribute to SD JOC rewrite

## WG 5 – Decision Making and Integration



### • Potential Resource Allocation Methods\*

- New focus on risk analysis methods

	Large Simulations	Model(s)	Benefit Cost Analysis	Risk Analysis	Gaming
QDR Focus Areas	Defeat terrorist networks	Potential in Long Term		FY08 POM & Long Term Goal	
	Defend Homeland in Depth				FY08 POM & Long Term Goal
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	Preventing the acquisition or use of WMD	FY08 POM & Long Term Goal	FY08 POM		FY08 POM & Long Term Goal

\* Caveat – WG 5 did not examine specific models and simulations.

### • Next steps

- For each QDR focus area and across the focus areas
  - Use creative new scenarios
  - Define functions
  - Identify capabilities to perform functions
  - Develop measures for each capability
  - Develop models and simulations to calculate measures

## Working Groups: Common Insights



### • People

- Need more diverse analytic teams with more social science/soft science experience

### • Data

- Where is it? How to acquire? What is available?
- Interaction between data, models and metrics

### • Methods

- Analytic Wargaming
- Non-M&S methods (risk analysis, cost-benefit analyst, social networks, game theory)
- Reasoning across an ensemble of models/tools

### • V&V

- How to accomplish V&V for new tools to a level that the decision maker will trust the outcomes

## The Workshop Message



- While there is some new tool development ongoing, we are really in the question definition, data gathering and methodology development stage for non-traditional analysis
- We need to open the lens and reach out to other disciplines and involve non-DoD agencies in the process



# MORS Workshop: Analysis for Non-Traditional Security Challenges: Methods and Tools

JHU/APL, Laurel, Maryland

21 – 23 February 2006

(Last Updated 1 December 2005)

## TERMS OF REFERENCE

### 1. Background

The current National Defense Strategy builds upon the efforts of the 2001 Quadrennial Defense Review and the dramatic changes in the security environment and lessons learned in the post 9-11 world. The strategy identifies four persistent and emerging challenges in this new, more uncertain area. The four challenges, traditional, irregular, catastrophic and disruptive, are depicted in the following graphic.

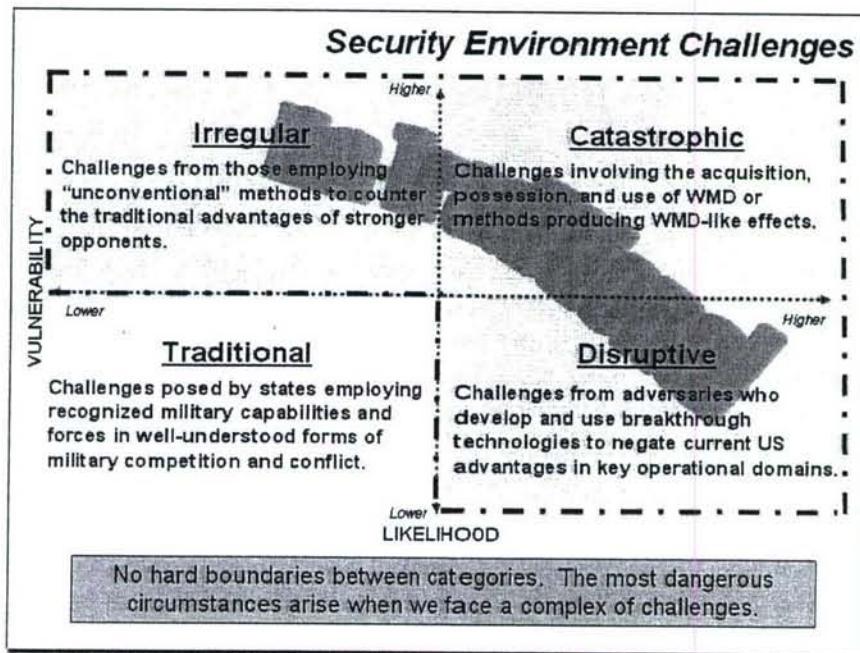


Figure 1

These persistent and emerging challenges are further defined in the 2006-2011 Strategic Planning Guidance which states that the defense strategy must be supported by capabilities and attributes that contend effectively with these challenges. Specifically, components are explicitly directed to reduce risk by developing capabilities to counter the persistent and emerging challenges.

A prerequisite for reforming the way DoD does business in acquisition, requirements and trades is the transformation of the Analytic System. The OSD

Analytic Agenda was created to achieve this purpose. It recognizes the changing nature of warfare brought about by new technologies, new missions and an enemy that is intelligent, unpredictable and continuously varying its patterns.

### *Analytic Agenda*

*100,000 Foot Level*

**DoD-wide agreement to make major, joint analysis efforts more effective, efficient, relevant**

- *Time Outputs to Decision Milestones (Planning and Budgeting)*
- *Improve Data, and Make It More Available*
- ***Improve Tools and Processes***
- *Create Baselines for Strategic Analysis (Current and Future)*
- *Accelerate the Deliberate Planning Process*



*"Creating the Sand Table for Planning and Acquisition"*

Our current modeling and simulation suites were evolved from Cold War models and have served us well. As we have continued to improve legacy models we have also invested a considerable effort to develop newer, more robust models to support the defense analytic process. However, the majority of modeling activity since the Cold War ended has continued to center on the analysis that supports traditional warfighting as we moved from the two simultaneous Major Theater Warfare strategies of the 1990s to the sequential Major Combat Operations strategy of this decade. As we attempt to seek ways to develop techniques to analyze the non-traditional areas, we have found that our familiar existing suite of tools is not well suited to examine the capabilities of the Joint force against these new challenges. This leads to the need for a workshop to facilitate cross-community identification and sharing of tools, new techniques and methodologies (such as agent based modeling) and new developments. The workshop is expected to provide immediate benefit to modeling developments and analytic support to provide insights to answer post 2005 QDR questions within the Department and in support of near-term component analytic plans and future Analyses of Alternatives.

## **2. Sponsor Interest**

Navy and Air Force have agreed to be co-proponents of this workshop. The idea of a workshop to expand on the Navy's internal World Class Modeling Workshop in June 2005 was originally discussed at the MORS Sponsors' luncheon at the

73rd MORSS. The meeting was again discussed during a World Class Modeling presentation at the 21 July 2005 Joint Analytic Data Management Steering Committee (JADM SC) and all of the remaining MORS Sponsors indicated interest and support. Following a meeting between the co-sponsors and OSD representatives, the concept was briefed at the JADM SC on 25 August.

### **3. Purpose, Goals and Objectives**

The purpose of the special meeting is to match stakeholder analytic gaps and deficiencies with potential methodology and modeling solutions in support of new developments in defense analytic requirements and capabilities. Specifically, the workshop is intended to:

- Illuminate user Non-traditional modeling and simulation gaps and deficiencies in the context of the defense security challenges and emerging changes in the defense strategy
- Identify areas of user commonality
- Capitalize on Joint/Service/Agency toolsets and ongoing model development for the larger community
- Develop partnerships to share future M&S development

The workshop will help to achieve the following longer-term goals and end-states for the DoD community and workshop stakeholders:

- Improve DoD analysis tools used for requirements determination, effectiveness evaluation and program planning
- Develop the ability to model emerging security challenges and new operational concepts: *Irregular, Catastrophic, Disruptive challenges, FORCENet, Effects-Based Ops, Distributed Ops concepts*
- Improve traceability of data through modeling hierarchy: *Engineering to Engagement to Mission to Campaign*
- Advance state of the art in M&S technology, practices, standards, and architectures
- Inform DoD analytic M&S community of important related activities

The following objectives will ensure a successful workshop:

- For Each Working Group:
  - Identify key stakeholder decision-makers [pre-workshop objective]
  - Examine analysis gaps and deficiencies needs from a stakeholder perspective [pre-workshop objective]
  - Determine commonalities between stakeholders
  - Examine common gaps and deficiencies and identify potential solutions in terms of methodologies, legacy M&S, modifications of legacy M&S or new M&S developments from a broader, enterprise-wide perspective
  - Explore potential partnerships for new M&S developments
  - Rank the M&S needs within each working group to provide an important advisory input for the Analytic M&S Master plan

### **4. Approach**

The Analysis for Non-Traditional Security Challenges Workshop will be organized into five working groups and one synthesis group which will address gaps and deficiencies in assessing the three non-traditional challenges (irregular, catastrophic and disruptive), deterrence and decision-making/collaboration methods. The workshop is predicated on analysis stakeholders having completed their gap analysis prior to the workshop so they can provide their needs as an input. This requires stakeholders to be identified 3-4 months prior to the conference to enable them to have time to complete the prerequisite analysis. Each breakout working session will then identify and compile commonalities and seek solutions. A solution could be in terms of an existing or new methodology such as an experiment or exercise lesson learned, a legacy or improvement to a legacy tool or a new M&S development. Overlapping/common gaps between stakeholders will be identified as potential for partnering. This could lead to a common study, or co-sponsored new development.

Concurrent with the workshop planning will be an IDA led effort to develop the DoD Analysis M&S Master Plan. To support this effort, an initial workshop is being planned in the November timeframe to identify M&S needs and M&S communities of interest. It is anticipated this workshop will not only help stakeholders begin the process for identifying gaps and deficiencies, but may also identify additional stakeholders for the MORS workshop. Subsequent M&S Master Plan workshops should also help to identify and the range of tools and even planned developments that can feed this workshop.

Two MORS workshops have been held this fall that will be leveraged for the Non-Traditional Workshop. The workshop on "Agent Based Models and Other Analytic Tools in Support of Stability Operations, was held at the SAIC Conference Center in McLean in late October and "Homeland Security – Homeland Defense Decision Support" was held in November at JHU/APL. Products from these workshops will be filtered to provide inputs as appropriate to this workshop.

**WG-1 Irregular/GWOT**— Irregular challenges to U.S. security interests are characterized by methods such as terrorism and insurgency with the intent of eroding U.S. influence, patience, and political will. Irregular opponents often take a long-term approach, attempting to impose prohibitive human material, financial and political costs on the U.S. to compel strategic retreat from a key region or course of action. Our experience with the war on terrorism points to the need to reorient our capabilities to contend with this irregular challenge more effectively. This working group will identify methods, tools and models that will focus on gaps and deficiencies for Irregular/GWOT areas such as:

- Counter-insurgency
- Counter-terrorism
- Distributed Operations
- Small Unit Operations
- Riverine Operations
- Foreign Internal Defense

- Critical Infrastructure Protection
- Maritime Domain Awareness
- Terrorists Networks
- Partnering/Shaping

WG-2 Disruptive — In rare instances, revolutionary technology and associated military innovation can fundamentally alter long-established concepts of warfare. Some potential adversaries are seeking such disruptive capabilities to exploit U.S. vulnerabilities and offset the current advantages of the U.S. and its partners. Disruptive breakthroughs in areas such as bio-technology, cyber-operations, space, or directed-energy weapons could seriously endanger our security. Identify maritime, land and air transportation tools, models, methods and metrics. This working group will identify methods, tools and models that will focus on gaps and deficiencies for Disruptive areas such as:

- Red and Blue Swarming Operations
- Bio-technology/Nanotechnology
- Stability Operations
- CNA Defense

WG-3 Catastrophic — In the face of American dominance in traditional forms of warfare, some hostile forces are seeking to acquire catastrophic capabilities, particularly weapons of mass destruction (WMD). Porous international borders, weak international controls, and easy access to information-related technologies facilitate these efforts. Particularly troublesome is the nexus of transnational terrorists, proliferation, and problem states that possess or seek WMD, increasing the risk of WMD attack against the United States. Proliferation of WMD technology and expertise makes contending with catastrophic challenges an urgent priority. Even a single catastrophic attack against the United States would be unacceptable. We will place greater emphasis on those capabilities that enable us to dissuade others from acquiring catastrophic capabilities, to deter their use and, when necessary to defeat them before they can be employed. This working group will identify methods, tools and models that will focus on gaps and deficiencies for catastrophic areas such as:

- WMD Elimination
- Effect of Nuclear/Biological attack
- Consequence Management/Foreign Consequence Management
- WMD Detection

WG-4 Deterrence — The Strategic Deterrence Joint Operating Concept (SD JOC) defines strategic deterrence as the prevention of adversary aggression or coercion threatening vital interests of the United States and/or our national survival. The central idea of the SD JOC is to exercise decisive influence over a potential adversary's strategic deterrence Center of Gravity: the decision-making calculus of key adversary decision-makers. Joint military operations and activities contribute to the "end" of strategic deterrence by affecting the adversary's decision calculus elements:

- Denying Benefits
- Imposing Costs
- Inducing Adversary Restraint

Military means required to affect the decision calculus will vary significantly depending on the adversary but fall into two categories: those that directly and decisively influence an adversary's decision calculus and those that enable such decisive influence.

Enabling "means" include:

- Global Situational Awareness
- Command and Control
- Overseas presence
- Allied Military Cooperation and Integration

Direct "means" include:

- Force Projection
- Nuclear Strike Capabilities
- Active and Passive Defenses
- Global Strike
- Strategic Deterrence Information Operations
- Inducement Operations
- Space Control

The SD JOC describes how each of these "means" contributes to the "ways" of achieving the strategic deterrence "end" and identifies how the joint force attributes identified in Joint Operations Concepts impacts these capabilities.

This working group will identify methods, tools and models that will focus on gaps and deficiencies for assessing the "means" to achieve the "ways" for the strategic deterrence end. New deterrence concepts (global, transnational and regional) proposed by the QDR may also be considered.

**WG-5 Decision Making and Integration** — Effective decision-making requires new methods and tools to incorporate Non-Traditional Challenges. Existing methods of collaboration will need to be reevaluated to consider the effects of incorporating the new challenges across all levels of classification. New developments in adaptive planning and course of action analysis must account for these new areas as well.

**Synthesis Group**— By definition, these working groups are not mutually exclusive. The inherent overlaps between the working groups provide synthesis points for integrating the conclusions from each as well as reducing the probability that major ideas will "fall through the cracks" between the workshop topics. The synthesis group will examine cross-group commonalities and insights and develop the overall workshops recommendations.

## 5. Workshop Planning and WG Chairs

### **Navy/Air Force Co-Proponents:**

Dr Jacqueline Henningsen, FS, Air Force  
Mr Trip Barber, Navy

### **Workshop Sponsor/Service POCs:**

Mr Royce Reiss (AFSAA) Co-Sponsor POC  
Ms Sunny Conwell (N81) Co-Sponsor POC  
Ms Renee Carlucci (MCCDC)  
Mr John Robertson (Army G-3)

### **Program Chairs:**

Mr Lee Dick (N81/Axiom Corp) [lee.dick@navy.mil](mailto:lee.dick@navy.mil), 703-693-8890  
**Co-Chair:** Dr Jim Harris (AFSAA) [James.Harris@pentagon.af.mil](mailto:James.Harris@pentagon.af.mil),  
703-588-8294

**Workshop Advisors:** Mr Jim Bexfield, FS, OSD  
Dr David Markowitz (CAA)

**Technical Advisor:** Trena Lilly, JHU/APL

### **WG1 – Irregular/GWOT**

*Chair: Dr Ed McGrady, CNA*  
*Co-Chair: Mr Mike Ottenberg, OSD-PAE/ATT*  
*Recorder: TBD*

### **WG 2 – Disruptive**

*Chair: Dr Mike Bailey, MCCDC*  
*Co-Chair: Mr Steve Farley, N81/ONR*  
*Recorder: TBD*

### **WG 3 – Catastrophic**

*Chair: Dr Al Sweetser, OSD (PA&E)*  
*Co-Chair: Mr Walt Zimmers, DTRA*  
*Recorder: TBD*

### **WG 4 – Deterrence**

*Chair: LTC Steve Riese, STRATCOM*  
*Co-Chair: Mr Mark Reid, MITRE*  
*Recorder: TBD*

### **WG 5 – Decision Making and Integration**

*Chair: Prof Greg Parnell, FS, USMA*  
*Co-Chair: Mr Steve Richter, JHU/APL*  
*Recorder: TBD*

## **WG 6 – *Synthesis***

*Chair: Mr Royce Reiss, AFSAA  
Co-Chair: Ms Sunny Conwell, N81*

### **6. Attendance**

Facility limitations will require attendance to be capped at about 250 people. The goal is to seek the right blend of stakeholders and industry/government developers. Quotas will be assigned to stakeholders and industry organization limits may be required to ensure diverse attendance. Invitations are expected to be extended to foreign nationals and may include non-TTCP countries. Target attendance will be about 35 per working group excluding the Synthesis Group depending on breakout room accommodations. The WAL has been reserved for WG-1 and will accommodate up to 80 with 50 seats reserved for using groupware.

### **7. Deliverables**

Several products will be generated from the workshop:

- An Executive Summary will be presented to the sponsors at the next JADM Steering Committee meeting subsequent to the workshop. The summary will address the workshop objectives, findings, conclusions and recommendations. This will be in the form of a report and a scripted briefing that lists gaps and shortfalls between the communities and opportunities for cooperation. This will include identification of current tools used by the communities and potential areas for tool and data sharing, as well as current repositories of data and information.
- A proceedings document containing summaries of all sessions in the form of annotated copies of plenary breakout session briefings.
- A detailed report of gaps and linkages will be provided as feedback to the Analysis M&S Master plan. This will likely be in spreadsheet form.
- An article summarizing the meeting and its findings will be produced and submitted to *PHALANX* in time for the next deadline after the meeting.
- A general session presentation will be made at the 74th MORSS.

## 8. Milestone Table

31 Aug 05	Draft TOR
8 Sep 05	Initial Organizing Committee meeting
Oct 05	EC approves TOR
Oct 05	Identify Working Group Chairs and Stakeholders
31 Jan 06	Pre-Planning workshop products due
21-23 Feb 06	Workshop
Mar 06	Post Workshop brief to sponsors at JADM SC
Mar 06	Draft article for PHALANX
Jun 06	Workshop Brief at MORSS Special Session

## 9. Planning and Organizing Committee

**General Chair:** Mr Lee Dick N81

**General Co-Chair:** Dr Jim Harris, AFSAA

**Advisors:** Mr Jim Bexfield, FS, OSD(PA&E)  
Dr David Markowitz (CAA)

**Synthesis Chair:** Mr Roy Reiss, AFSAA

**Synthesis Co-Chair:** Ms Sunny Conwell, N81

**Synthesis WG:** Dr Tom Allen FS, IDA  
Mr Greg Keethler, LMCO  
John Robertson, Army G-3  
Renee Carlucci, MCCDC  
Jim Stevens, OSD PA&E  
Bob Orlov, Joint Staff J8  
Dr Roy Rice, FS, TBE

**Site Coordinator/Poster Session Coordinator:** Trena Lilly, JHU/APL

**Administrative Coordinators:** Brian Engler, Executive Vice-President, MORS  
and Natalie Kelly, Vice-President for Administration, MORS

**MORS Bulldog:** Annie Patenaude

### **Sponsor/Service Reps:**

**Air Force:** Roy Reiss, AFSAA

**Army:** COL Hòa Generazio, ODUSA(OR)

**Navy:** Herb Cupo, N81

**Marine Corps:** Col Greg Reuss, MCCDC S&A

**Joint Staff:** Bob Orlov, Joint Staff (J8)

**OSD:** Jim Bexfield, FS, OSD(PA&E)

## 10. Administrative

**Name:** Analysis for Non-Traditional Security Challenges: Methods and Tools

**Dates:** 21-23 February 2006

**Location:** The Johns Hopkins University/Applied Physics Laboratory, Laurel, MD

**Fees:** US Federal Government \$310 and \$545 for all others; Plenary (1 day only) Government \$160; Non-Government \$280

**Attendance:** 250 people, by invitation

**Classification:** The Workshop will be unclassified. Presentations with FOUO and/or limited distribution markings will not be distributed electronically or made available as a printed copy to the general audience. Distribution of these materials will be determined by the originator. Post workshop products such as the *PHALANX* article, executive outbrief, and 75<sup>th</sup> MORSS presentation will be cleared for public release and may be posted on the website.

## 11. Agenda

### Process for Day 1

Morning:

0700-0800	Check in and Registration
0800-0810	MORS President Welcome
0810-0820	Sponsor Welcome/Keynote Intro
0820-0900	Navy Sponsor Welcome and Keynote Speaker Intro
0900-0915	Break
0915-0940	Analysis M&S Master Plan Update [IDA]
0940-1010	QDR Debrief – Gaps and Shortfalls [OSD(PA&E)/J8]
1010-1030	Navy WCM Initiatives
1030-1050	AFSAA M&S Initiatives
1050-1110	Center for Army Analysis M&S Initiatives
1110-1130	MCCDC M&S Initiatives

Afternoon

1130-1300	Working lunch in breakout rooms/WG intros/way ahead
1300-1430	COCOM Panel (J-8 chair)
1430-1445	Break
1445-1700	Breakout sessions in WGs
1700	Mixer

### Process for Day 2

0800-1600	Breakout sessions
1600-1700	10 min plenary updates by WG chairs

### Process for Day 3

0800-0940	Breakout sessions continue
0940-1000	Break
1000-1200	Prep WG Session outbriefs
1300-1415	WG session out briefs (25 min per WG + Synthesis Group)
1415-1430	Break
1430-1545	Continue session out briefs
1545-1600	Break
1600-1630	Sponsor concluding remarks